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1981 Chemical Weed Control Guide for Field Crops & Perennial Weeds

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INTRODUCTION

THE WEED CONTROL SUGGESTIONS are based on Federal label clearances and on information obtained from the North Dakota Agricultural Experiment Station and the Research Report of the North Central Weed Control Conference.

CAUTION:
The weed control suggestions in this circular are based on the assumption that all herbicides mentioned in this guide will continue to have a registered label with the Environmental Protection Agency.

USE PESTICIDES ONLY AS LABELED.

RATES ARE BASED on broadcast application and are expressed as active ingredient or acid equivalent, and as the amount of commercial product. Commercial formulations of the same herbicide may vary in their amount of active ingredient. For example, a pint of 3.3-pound acid equivalent per gallon contains 0.4 pound, and a pint of 6-pound acid equivalent per gallon contains 0.75 pound. Three pounds of atrazine (AAtrex 80W) powder contains 2.4 pounds active ingredient (3 x 0.80 = 2.4), or 3 pounds active ingredient

HERBICIDE USE INFORMATION

1. POSTEMERGENCE HERBICIDE effectiveness is influenced by crop tolerance, weed species and climatic conditions and should be considered in determining the rate of herbicide to apply. A range of rates is given for most of the herbicides in this circular. Use the lowest recommended rate of postemergence herbicides under favorable growing conditions when weeds are small and actively growing. Under adverse conditions of drouth or prolonged cool weather, or for well established weeds, use the highest suggested rate, except for barban (Carbyne). (See paragraph 118.)
2. Ideal temperatures for applying most postemergence herbicides are between 65 and 85 F. Below 60 F weeds are killed very slowly or not at all; above 85 F there is danger of herbicide injury to the crop. Avoid applying volatile herbicides such as 2,4-D ester, MCPA ester and dicamba (Banvel) during hot weather, especially near sensitive broadleaf crops, shelterbelts or farmsteads.
3. Rainfall shortly after application often reduces weed control from postemergence applications because the herbicide is washed off the leaves before absorption is complete. Herbicides vary in rate of absorption and in ease of being washed from leaves; therefore, herbicides vary in

spray drift injury, wind direction should be away from susceptible crops during herbicide application. The wind velocity should be less than 10 miles per hour, however, drift can occur even with lower wind velocities.

c) Distance between nozzle and target (boom height): Droplets should be released as close to the target as possible since less

distance means less time to fall and therefore less drift.

d) Herbicide formulation: All herbicides can drift as spray droplets but some herbicides are sufficiently volatile to cause plant injury from vapor or fume drift. 2,4-D and MCPA are formulated as amines or esters. The ester forumulations may form damaging vapors while the amines are essentially nonvolatile. Dicamba (Banvel) is also volatile and can drift as droplets or vapor. Herbicide vapor drifts further and over a longer time than spray droplets. A wind blowing away from susceptible plants during application will prevent damage from droplet drift but a later wind shift towards the susceptible plants could move damaging vapors to the plants. Thus, to minimize the risk of drift injury, herbicides with high potential to form damaging vapors such as 2,4-D esters, MCPA esters, and dicamba should not be used near susceptible plants.

5. Herbicide volatility and thus risk of damage to susceptible plants increases with increasing temperature. The so-called high volatile esters of 2,4-D or MCPA may produce damaging vapors at temperatures as low as 40°F while low volatile esters may produce damaging vapors between 70 and 90°F. Amine formulations are essentially nonvolatile. The temperature on the soil surface often is several degrees warmer than air temperature, thus an applied low volatile ester could be exposed to temperatures high enough to cause damaging vapor formation even when the air temperature was below 70 F.

   e) Drift control: Certain spray nozzles or spray systems such as the Delavan Raindrop nozzle, the Spraying Systems LP nozzle or controlled droplet applicators produce droplets less subject to drift. Nalco-Trol, an additive to spray mixtures, causes larger droplets which reduces shift.

   f) Drift injury from herbicides: Damaging drift to nontarget plants is primarily a problem with 2,4-D, MCPA, dicamba (Banvel), paraquat, glyphosate (Roundup) and picloram (Tordon) in North Dakota. Other herbicides may drift but generally do not cause significant damage. Drift control techniques should not be used with postemergence herbicides that require small droplets for optimum performance such as barban (Carbyne), desmedipham (Betanex) and bentazon (Basagran).

6. PREEMERGENCE HERBICIDES: Good weed control with preemergence herbicides depends on many factors, including rainfall after application, soil moisture, soil temperature, soil type and weed species. For these reasons, preemergence chemicals applied to the soil surface sometimes fail to give satisfactory weed control. Herbicides which are incorporated into the soil surface usually require less rainfall after application for effective weed control than unincorporated herbicides. Weeds emerging through a preemergence herbicide treatment may be controlled by rotary hoeing without reducing the effect of the herbicide.

7. INCORPORATION OF HERBICIDES: Many herbicides which are applied before crop and weed emergence need to be incorporated to give optimum weed control. Included in this group are butylate (Sutan), cycloate (Ro-Neet), diallate (Avadex), EPTC (Eptam, Eradicane), fluchloralin (Basalin), profluralin (Tolban), triallate (Far-go) and trifluralin (Treflan). Incorporation of alachlor (Lasso), ethofumesate (Nortron), Metolachlor (Dual) and pendimethalin (Prowl) generally improves weed control.

8. Butylate, cycloate, diallate, EPTC and triallate should be incorporated immediately (within minutes) after application. Incorporation of profluralin may be delayed for four hours if applied to a loose, dry soil. Incorporate fluchloralin within eight hours of application. Trifluralin incorporation may be delayed up to 24 hours if applied to a cool, dry soil and if wind velocity is less than 10 mph. Pendimethalin must be used preemergence on corn but may be incorporated for soybeans. Incorporation often improves the performance of pendimethalin and may be delayed up to seven days after application. Alachlor, ethofumesate and metolachlor may be used preemergence but incorporation often improves performance especially on fine textured soils. Incorporation of alachlor, ethofumesate and metolachlor may be delayed several days.

9. An estimate of the efficiency of an incorporating tool can be obtained by operating the tool through flour or lime which has been spread thickly over the soil. A thorough incorporation should cover most of the flour or lime and mix it uniformly through the soil. Several tillage tools have

been used successfully for the incorporation of herbicides. Some herbicides require more thorough incorporation than others and the incorporation method should be appropriate for the herbicide.

10. Butylate, cycloate, EPTC, fluchloralin, profluralin and trifluralin require a thorough incorporation and should be incorporated by one of the following methods or a method which will incorporate similarly.

    a) A tandem disk should be set at a depth of 3 to 4 inches for fluchloralin and a depth of 4 to 6 inches for others. Operating speed should be 4 to 6 mph.

    b) Field cultivators of various types may be used. These should have overlapping sweep shovels with at least three rows of gangs and the operating depth should be 3 to 4 inches for fluchloralin and 4 to 6 inches for the others. A harrow should follow the field cultivator. The operating speed necessary to achieve a satisfactory incorporation will vary somewhat depending on the type of field cultivator but the speed usually will be 6 to 8 mph.

    c) Power driven rototiller type equipment will give adequate incorporation when set to operate at a depth of 2 to 3 inches at the manufacturer's recommended ground speed.

11. A single incorporation with a power driven tiller is sufficient for butylate, cycloate, EPTC, fluchloralin, profluralin and trifluralin. However, a second tillage at right angles to the initial incorporation should be done if the disc or field cultivator is used. The second incorporation has two purposes: a) Most of the herbicide left on the surface after the first incorporation will be mixed into the soil with the second tillage, and b) the second tillage will give more uniform distribution of the herbicide in the soil which will improve weed control and reduce crop injury.

12. Trifluralin (Treflan) may be applied to wheat after planting and then incorporated above the seed. Shallow incorporation of trifluralin does not give as effective weed control as a deep incorporation, but fair to good control of shallow germinating weeds such as green and yellow foxtail (pigeongrass) can be obtained.

13. Diallate (Avadex) and triallate (Far-go) will adequately control wild oats with a shallow incorporation. Two spike tooth harrowings at right angles will give sufficient incorporation if the soil is loose and free of trash. Experiments at North Dakota State University have shown that deeper incorporation did not reduce wild oat control from diallate or triallate and even gave better control of deep germinating wild oats. However, triallate used on wheat or durum should be incorporated less deeply than the placement of the crop seed. Crop injury may result if triallate contacts the wheat seed after incorporation. Triallate can contact barley seed without crop injury.

14. Pendimethalin (Prowl) does not require deep incorporation, but deep incorporation will not reduce weed control. A tillage tool operating at a minimum depth of 2 inches will give adequate incorporation.

15. THE SOIL ORGANIC MATTER TEST: Certain herbicides are partially adsorbed and inactivated by soil organic matter, so knowledge of the organic matter level will serve as a guide in selecting an effective herbicide and an effective herbicide rate. Herbicides such as atrazine, cycloate (Ro-Neet), EPTC (Eptam), linuron (Lorox) and pyrazon (Pyramin) require higher rates to be effective in high organic matter soils. However, crop safety may be marginal on low organic matter soils. Herbicides also are adsorbed to the clay fraction in a soil, thereby reducing weed control. However, organic matter level generally affects herbicide performance more than clay content.

16. EPTC is used on sugarbeets, sunflower, dry beans and potatoes. Sugarbeets have marginal tolerance to EPTC, so the rate must be adjusted on various soils to give good weed control without crop injury. The following discussion on selecting an EPTC rate only gives guidelines. Other factors such as method of incorporation affect EPTC performance (immediate and thorough incorporation gives best performance). Rates must be adapted for individual conditions. The suggested spring-applied EPTC rate is 2 to 3 lb/A. The 3 lb/A rate should give good weed control without crop injury on a soil with a silty clay texture and more than 7 percent organic matter. The minimum rate of 2 lb/A may injure

sugarbeets on a sandy loam or coarser textured soil with less than 4 percent organic matter. The EPTC rate should be adjusted within the 2 to 3 lb/A range when the soil is intermediate between the two extremes. EPTC at 2.5 lb/A should give good weed control and little crop injury on clay loams or finer textured soils with more than 5 percent organic matter.

17. Some herbicides give good weed control only when organic matter levels are low. Linuron (Lorox) and pyrazon (Pyramin) have not been effective in the Red River Valley, except on the coarser textured soils with less than 5 percent organic matter. The lower the organic matter, the more effective they become. The atrazine rate must be adjusted according to organic matter levels. Apply the higher labeled rates on higher organic matter soils. Many herbicides such as diallate (Avadex), propachlor (Ramrod, Bexton), triallate (Far-go) and trifluralin (Treflan) and most postemergence herbicides are affected only slightly by organic matter levels. Organic matter levels should be determined on each field where organic matter sensitive herbicides are to be used. Organic matter levels change very slowly and testing once every five years would be adequate.

18. FALL APPLICATION OF HERBICIDES: Several herbicides may be applied in the fall for weed control the following spring. Included in this group are diallate (Avadex), EPTC (Eptam), triallate (Far-go) and trifluralin (Treflan). Fall treatments should be applied after October 15 and until soil freeze-up. Application of herbicides after October 15 when soil temperature has cooled minimizes herbicide loss by volatilization, and microbial and chemical degradation. Both granular and liquid formulations of the herbicides are registered for use in the fall. Fall applications of granular formulations generally have given more effective weed control than the liquid formulations, especially under heavy crop residue situations.

19. Diallate (Avadex) applied at 1.25 to 2 lb/A in the fall controls wild oats. Diallate is volatile and must be incorporated into the upper 2 inches of soil immediately after application to prevent loss by evaporation. The liquid formulation of diallate may be applied in the fall for wild oat control in flax, barley and sugarbeets. The granular formulation of diallate is registered for use on sugarbeets only.

20. EPTC (Eptam) fall applied at 4 to 4.5 lb/A gives good control of annual grasses and certain broadleaf weeds. EPTC must be incorporated into the soil immediately after application to prevent loss of herbicide. The liquid and granular formulation of EPTC may be applied in the fall for weed control in dry beans, flax, potatoes, sugarbeets and sunflower.

21. Triallate (Far-go) is applied at 1 to 1.5 lb/A in the fall. Triallate should be incorporated immediately after application. The liquid formulation may be applied at 1 to 1.25 lb/A and the granules at 1.25 to 1.5 lb/A for wild oat control in barley, wheat and durum. However, work at North Dakota State University with fall applications indicates that at similar rates the granular formulation performs more effectively than the liquid formulation.

22. Trifluralin (Treflan) fall applied at 0.5 to 1 lb/A gives good control of annual grasses and broadleaf weeds except wild mustard. Incorporation may be delayed 24 hours if applied to a cool, dry soil and if wind velocity is less than 10 mph. The liquid formulation may be applied in the fall for weed control in soybeans, safflower, dry beans and sunflower (Red River Valley only). The granular formulation may be applied in the fall for weed control in soybeans, safflower, dry beans and sunflower (statewide).

23. HERBICIDE COMBINATIONS: The effect of postemergence herbicides often is increased when applied to areas already treated with a preemergence or preplant herbicide. Combinations of certain postemergence herbicides or preemergence herbicides may give better weed control than use of the individual herbicide alone. However, loss of weed control or increased crop damage may result from the use of certain other herbicides in combination. Herbicide combinations should be used with caution until experience or research has shown that the combination is effective and safe. See the discussion on individual crops for more specific information.

24. All agricultural pesticides which are tank mixed should be registered for use as a mixture by the Environmental Protection Agency. Agricultural pesticides may be tank mixed if all pesticides in the mixture are registered by the Environmental Protection Agency on the crop being treated. However, users must assume liability for crop injury, inadequate weed control and illegal residues.

25. HERBICIDE-FERTILIZER COMBINATIONS: Thorough mixing and continuous vigorous agitation are required to obtain an even application of herbicide-fertilizer combinations. Some herbicide-fertilizer combinations will not form a uniform mixture even with thorough agitation. Compatibility of the herbicide in the liquid fertilizer should be tested before the herbicide is added to the tank.

26. The compatibility test may be conducted by combining small quantities of the components being mixed in the same proportions used in the spray tank. Generally, mix 1 pint of fertilizer and 2 teaspoons of the liquid herbicide. For wettable powders, mix 2 teaspoons of powder with a small quantity of water to form a slurry, and add the slurry to the fertilizer. Close the jar and shake well. Watch the mixture for several seconds and check again 30 minutes later. If the mixture does not separate, the combination is compatible. If the mixture separates or gets very thick or syrupy, do not combine for field application. Mixing ability may be improved by adding a compatibility agent such as Compex or Unite. Different batches of fertilizer may differ in their mixing properties so should be tested separately.

27. HERBICIDE RESIDUE or the persistence of phytotoxic levels of a herbicide for more than 1 year can be a problem with some of the herbicides used in North Dakota. Herbicide residues are most likely to occur following years with unusually low rainfall because chemical and microbial activity needed to degrade herbicides is limited in dry soil. Crop damage from herbicide residues can be minimized by application of the lowest herbicide rate which will give good weed control, by using band rather than broadcast applications, and by moldboard plowing before planting the next crop. Moldboard plowing reduces phytotoxicity by diluting the herbicide residue in a large volume of soil.

28. Herbicide residues can be detected by bioassay. A soil sample representative of the whole field must be obtained by sampling at many places to the depth of the tillage layer. Also, a sample of soil known to be free of herbicide residues must be obtained from near the treated field to serve as the untreated check. The samples should be dried and the clods broken so that the largest particles are no larger than a wheat kernel. Prepare at least two samples each of the untreated check soil and the test soil in pots or other containers with holes in the bottom for water drainage. The crop to be grown in the field should be used as one bioassay species. Preparing extra pots and testing a more susceptible species may be helpful in detecting residues. Plant in each pot 12 seeds of large-seeded crops like corn or soybeans, or 20 seeds of small seeded crops like cereals or flax. Water the soil for germination and plant growth as needed, but do not over-water. When the plants are about 2 inches tall, thin to about six large-seeded or 12 small-seeded uniform seedings in each container. The containers should be placed in a warm place at about 70 to 75 F, and in direct sunlight during the day. Observe the plants in the untreated check and test samples for two to three weeks after emergence. Some tangible measurements such as plant height and leaf length can be taken for evaluation, along with visual observation of abnormalities. Symptoms of some herbicides, like atrazine and metribuzin develop slowly after food reserves in the seed have been depleted so symptoms may not be apparent soon after emergence. The soil should be washed from the roots to observe root growth, especially for dinitroaniline herbicides such as fluchloralin (Basalin), pendimethalin (Prowl), profluralin (Tolban) and trifluralin (Treflan).

29. Atrazine generally has a residue the year following application to corn at 2 to 4 lb/A in North Dakota. If soil moisture is deficient, 1 lb/A of atrazine may cause injury to susceptible crops the following year. Corn and millet are tolerant to atrazine while other crops vary in susceptibility. The approximate ranking of other crops from most

to least tolerant is flax, soybeans, barley, wheat, oats, sunflower and sugarbeets.

30. Fluchloralin (Basalin), profluralin (Tolban) and trifluralin (Treflan) are similar herbicides called dinitroanilines. Under dry soil conditions these herbicides can persist in the soil for more than one year. Sunflower, soybeans, potatoes and dry edible beans are quite tolerant to dinitroaniline herbicides. The approximate ranking of other crops from most to least tolerant is flax, barley, wheat, oats, corn and sugarbeets. Approximately 7 inches of rainfall between planting and freeze-up will be sufficient to dissipate 0.75 lb/A of trifluralin, profluralin, or fluchloralin while approximately 11 inches would be required to dissipate 1 lb/A to a level where most crops can be grown, except sugarbeets. Sugarbeets are very susceptible to these herbicides but moldboard plowing plus adequate rainfall generally will prevent injury to this crop.

31. Picloram (Tordon) at 1/64 lb/A active ingredient (1 oz/A of formulated product) may carry over in the soil for more than 1 crop year. Only grass or grain crops such as small grains, corn, sorghum, or flax should be planted on fields treated with picloram the previous year. Sunflower, soybeans, dry edible beans and potatoes are especially susceptible to picloram.

32. Metribuzin (Lexone, Sencor) generally is used on soybeans in combination with other herbicides or is used on potatoes alone. No harmful metribuzin residues would be expected when used at 0.25 lb/A active ingredient. Rates over 0.5 lb/A may damage susceptible crops the next year. The approximate ranking of crops from most to least tolerant are potatoes, soybeans, dry edible beans, corn, barley, wheat, oats, sunflower, flax and sugarbeets.

33. Ethofumesate (Nortron) often has a residue the year following use on sugarbeets. Crops most likely to be damaged by ethofumesate residue are wheat, barley and oats. Moldboard plowing usually will eliminate crop injury. Ethofumesate should be applied in a band to reduce cost and reduce potential crop injury from residues the following year.

SMALL GRAINS—SPRING WHEAT (INCLUDING DURUM), BARLEY AND OATS

34. Weed control in small grains is important to maximize yields. Broadleaf weeds, foxtails (pigeongrass) and wild oats infest small grains statewide. Several applications of different herbicides or mixtures may be required to control all weeds. Normal height wheat varieties, rye and winter wheat are more competitive than semidwarf wheat and will increase the effectiveness of herbicides. All small grains are sensitive to 2,4-D during the seedling stage but can be treated safely with MCPA from emergence until the early boot stage. Do not treat small grains in the boot stage. Wheat and barley, when treated from the fifth leaf to the early boot stage, are more tolerant than oats to 2,4-D applications. Oats is more tolerant to MCPA than to 2,4-D, but injury to oats is possible with either chemical at any growth stage. Use 2,4-D on oats only for such hard-to-kill weeds as Russian thistle, kochia, common ragweed, and redroot pigweed and when the crop is in the third to fourth leaf stage. While some injury to the oats can be expected, the better control of these weeds with 2,4-D usually will compensate for any yield loss caused by the chemical. Oat varieties vary in their tolerance to 2,4-D but wheat and barley varieties differ little in tolerance.

35. Dicamba (Banvel) at 0.06 to 0.12 lb/A controls wild buckwheat, smartweed and certain other broadleaf weeds in wheat and oats. Dicamba can be applied alone but usually is applied with MCPA to increase control of wild mustard and other broadleaf weeds. Oats is more tolerant to dicamba than wheat. Both crops must be treated at the second through fourth leaf stage. Barley is more susceptible to injury from dicamba than wheat or oats. Dicamba can be applied in combination with 2,4-D to wheat in the 4 leaf stage.

36. Picloram (Tordon) at 1/64 lb/A with 0.25 to 0.37 lb/A of 2,4-D or MCPA is labeled for broadleaf weed control in wheat, barley and oats. Picloram may be applied during the three through five leaf stage of crop growth. NOTE: Picloram should be used only on land that will be planted the following year to grass or grain crops including small grains, corn, sorghum, and flax. See herbicide residue section, paragraph 31.

37. Bromoxynil (Buctril, Brominal) controls wild buckwheat, fumitory and most annual

broadleaf weeds in wheat, barley and oats from emergence of the crop to early boot. Mixtures of bromoxynil plus MCPA ester (Bronate, Brominal Plus) are applied from the 3 leaf to early boot stage to improve wild mustard control.

38. Small grains underseeded to sweetclover, alfalfa, or other legumes cannot be treated with 2,4-D, MCPA, bromoxynil, dicamba or picloram at rates required to control most broadleaf weeds without seriously injuring or killing the legumes.

39. FOXTAIL CONTROL: Foxtail commonly infests small grains in North Dakota. Foxtail usually is most competitive when small grains are seeded late and soil temperatures are warm for foxtail germination and rapid growth. Fields which have been chisel plowed generally have more foxtail than moldboard plowed fields. Moldboard plowing buries the foxtail seed which prevents emergence and reduces viable seed for subsequent years.

40. Diclofop (Hoelon) at 0.75 to 1.25 lb/A in wheat or 0.75 to 1 lb/A in barley applied postemergence controls foxtail in addition to wild oats. The lower rate is for green foxtail and yellow foxtail with one to three leaves. The higher rates are for foxtail growing in dry conditions or for foxtail with three to four leaves. Research at NDSU has indicated green foxtail is more susceptible than yellow foxtail to diclofop. (See wild oats section for information on diclofop mixtures with other herbicides, paragraph 120).

41. Propanil (Stampede 3E) at 1.12 to 1.5 lb/A should be applied to two to four leaf stage foxtail in four leaf or smaller hard red spring wheat. The higher rate should only be used when foxtail has three to four leaves and wheat has four leaves or less. Applications to foxtail larger than 3 leaves or wheat larger than 4 leaves may result in reduced weed control or increased wheat injury. Propanil is not translocated so good weed coverage by the spray is essential. Propanil should only be applied when temperatures at or after application are between 65 and 85 F and plants are in active growth with adequate soil moisture within 2 inches of the surface. Propanil is not registered for durum wheat because of potential crop injury. Propanil also controls wild buckwheat, redroot pigweed, prostrate pigweed, common lambsquarters, wild mustard and kochia in the 2 to 4 leaf stage. Propanil should not be applied to wheat treated with carbamate or organophosphate insecticides or wheat grown on soil treated the previous year with organophosphate insecticides.

42. Trifluralin (Treflan) at 0.5 to 0.75 lb/A and harrow incorporated shallowly after seeding is labeled for foxtail (pigeongrass) control in wheat. The lower rate is for use on coarse textured soils and the higher rate on fine textured soils. Incorporation should be by harrowing twice at right angles and the depth of incorporation of the herbicide must be above the wheat seed. The wheat should be seeded 2 to 2.5 inches deep to permit incorporation above the seed. Some wheat varieties, especially semidwarfs, emerge poorly from deep seeding so seed should be placed no deeper than 2 to 2.5 inches. A heavy rain or irrigation immediately after trifluralin application has caused wheat injury on light and medium textured soils. Trifluralin applied in this manner does not control wild oats. (See wild oats section for discussion on trifluralin-triallate combination, paragraph 114.)

43. VOLUNTEER SUNFLOWER: Volunteer sunflower is often a problem in small grains seeded in the rotation the year after sunflower and occasionally the second year. Tillage practices distribute the sunflower seeds to various depths in the soil causing emergence over several days or weeks depending on climatic conditions. Judgment may be needed in determining the time of herbicide application. Early herbicide application would not control late emerging sunflower and late application would allow competition from the early emerged sunflower. Generally application should be before the first sunflower is 4 inches tall and a second application may be needed for late emerging sunflower.

44. Bromoxynil at 0.25 lb/A plus MCPA ester at 0.25 lb/A (Brominal plus, Bronate) give excellent control of volunteer sunflower. Treated sunflower appear severely burned within several days and die within about one week. Dicamba (Banvel) at 0.12 lb/A plus MCPA amine at 0.25 lb/A (Mondak), 2,4-D or MCPA at 0.5 lb/A, and picloram (Tordon) at 1/64 lb/A plus 2,4-D or MCPA at 0.37 lb/A all give good control of volunteer sunflower. These treatments will cause the sunflower to stop growing shortly after treatment, but they may remain green and alive for several weeks or more, depending

on climatic conditions and crop cometition. The approximate order of effectiveness on volunteer sunflower from most to least effective is Bromoxynil + MCPA, dicamba + MCPA, 2,4-D + picloram, 2,4-D and MCPA.

45. KOCHIA: Kochia is an exceptionally competitive weed and a few uncontrolled plants can cause severe yield losses. The proper rates and spray volumes of herbicides should be used to maximize control. Dicamba (Banvel) at 0.125 lb/A plus MCPA amine at 0.25 lb/A gives good kochia control. 2,4-D at 0.5 lb/A gives good kochia control, but good spray coverage is essential because 2,4-D does not translocate readily in kochia. Treatment should be to small plants (less than 3 inches tall) or large spray volumes should be used to penetrate the kochia foliage. MCPA is less effective for kochia control than 2,4-D. However, MCPA at 0.5 lb/A will control small kochia. Bromoxynil at 0.25 lb/A plus MCPA at 0.25 lb/A also gives good control of kochia, but plants should be small and spray coverage good. Picloram (Tordon) is not effective on kochia, but when combined with 2,4-D at 0.37 lb/A, especially the ester, the control is good.

46. REDROOT PIGWEED: Redroot pigweed is another important weed in small grains. Rates of most herbicides need to be higher for redroot pigweed control than for control of wild mustard. Dicamba at 0.12 lb/A plus MCPA at 0.25 lb/A, 2,4-D at 0.5 lb/A, bromoxynil at 0.25 lb/A plus MCPA at 0.25 lb/A, and picloram at 1/64 plus 2,4-D at 0.37 lb/A all give good redroot pigweed control. MCPA is less effective than 2,4-D for redroot pigweed control. The esters of 2,4-D or MCPA are generally more effective than the amines for redroot pigweed control.

47. FALSE CHAMOMILE: False Chamomile is an important weed in small grains in north central and northeastern North Dakota. False chamomile is resistant to most of the herbicides used in small grain. Bromoxynil at 0.37 lb/A plus MCPA at 0.37 lb/A gives fair to good control of small spring emerging false chamomile. The fall emerging plants which survive spring seedbed preparation are usually too large at treatment for adequate control. Thorough fall and spring tillage is essential to control fall emerged chamomile. False chamomile less than 6 inches tall in tree rows and around potholes can be controlled with paraquat at 0.5 lb/A with X-77 or other nonionic surfactant at 1 quart per 100 gallons of water. Glyphosate (Roundup) at 0.75 and amitrole (Amitrole T, Cytrol) at 1.5 lb/A controls false chamomile less than 6 inches tall and can be used in tree rows and around potholes. Avoid drift to tree foliage when applying glyphosate or amitrole.

48. HARROWING FOR WEED CONTROL in small grains: Harrowing a few days after a spring sown crop has sprouted but before it has emerged is effective in reducing stands of foxtail (pigeongrass), wild oats and other weeds. The weeds must be emerging. Since foxtail is shallow rooted and easily controlled, set the teeth back on the harrow to minimize crop injury. Small grains can be harrowed after they have emerged and have two to four leaves but before tillering. Soil moisture should be good but with a dry solid surface. Wheat can be harrowed one to three times, but barley only once. Oats normally is not harrowed because it is injured more easily than wheat and barley.

FLAX

49. Flax is less competitive with weeds than are small grains, and should be grown on relatively weed-free fields. Early after-harvest tillage of small grain stubble will prevent weed seed production, control perennial weeds and encourage annual weed seed germination prior to freeze-up. Weed problems will be reduced when weeds are controlled in the preceding crop. Flax may be seeded directly or with shallow spring tillage in fields which did not have weed seed produced the previous year. Deep tillage on such fields could bring dormant seeds to the surface, increasing weed problems. Moldboard plowing after a year of weed seed production buries the seed, reducing the infestation in the following crop season. Moldboard plowing is especially effective in reducing infestations of small seeded weeds like foxtail which have short seed survival. Delayed seeding of flax with tillage prior to seeding will control wild oats and reduce infestation of other early germinating weeds. However, delayed seeding generally reduces flax yields. Early maturing flax varieties should be used with late seeding.

50. EPTC (Eptam) fall applied at 4 lb/A controls annual grass weeds, including wild oats, and some broadleaf weeds in flax. Fall applied EPTC at 3 lb/A generally has given good control with less flax injury than 4 lb/A in course textured soils. Incorporate EPTC immediately (within minutes) and thoroughly after application. (See para-

graph 10 for incorporation discussion.) EPTC is the only soil applied herbicide for general weed control in flax. However, flax tolerance to EPTC is marginal. Stunted plants and stand reduction are symptoms of flax injury from EPTC. Usually, flax yields will not be reduced because the remaining plants will recover, branch out and compensate for a thin stand. However, with severe injury the stand may be thinned to the point where yield is reduced. Each grower should try EPTC on a small acreage of flax on the lighter soils to determine if the benefits from the EPTC offset possible injury. Spring applied EPTC for flax was removed from registration for 1981.

51. Postemergence herbicides should be applied as early as possible in flax to achieve better weed control, less competition and less flax injury.

52. MCPA at 0.25 lb/A on 2 to 6-inch flax controls most broadleaf weeds. MCPA amine rates higher than 0.25 lb/A and MCPA ester should be used in flax only for the more resistant weeds.

53. Bromoxynil (Brominal, Buctril) at 0.25 to 0.5 lb/A on 2 to 6-inch flax controls wild buckwheat, volunteer sunflower and most broadleaf weeds. Some leaf burn may be observed at the higher rates or if high temperatures follow application. Bromoxynil should not be mixed with MCPA for weed control in flax.

54. Dalapon (Dowpon) will control green and yellow foxtail (pigeongrass) in young flax. Apply dalapon as soon as possible after flax is 1 inch tall and the weeds less than 2 inches for best results. **Caution:** Spraying must be completed prior to 6 inches tall or the early bud stage, whichever is earlier, to minimize flax injury. Generally dalapon is applied in a mixture with MCPA amine to control both the susceptible grass and broadleaf weeds with one application.

55. Barban (Carbyne) and diallate (Avadex) for wild oats control are discussed in paragraphs 113 to 118.

CORN

56. A combination of cultural, mechanical and chemical methods is necessary for consistently effective weed control in corn. Control early germinating weeds by cultivation before planting if conventional tillage is used. A rotary hoe can be used to control emerging weeds when the corn is beyond the spike stage. Cultivation between the rows should be done soon after weeds emerge.

57. Most herbicides used in corn are labeled for tank mixing with other herbicides for broad spectrum weed control. Some of the combinations best adapted to North Dakota are given in the chemical weed control tables. Consult the label and discussion of individual herbicides for a complete list of all possible registered combinations.

58. PREEMERGENCE atrazine (AAtrex, Atrazine) at 2 to 4 lb/A gives good control of annual weeds without crop injury. Fine textured soils with high organic matter require a 4 lb/A application. Atrazine residues injurious to susceptible crops may remain in soils longer than one growing season. (See paragraph 29 in herbicide residue section for additional discussion.) Atrazine is registered as a tank mixture with alachlor (Lasso), cyanazine (Bladex), metolachlor (Dual), propachlor (Bexton, Propachlor, Ramrod), simazine (Princep) and simazine plus paraquat.

59. Alachlor (Lasso) and metolachlor (Dual) at 2 to 3 lb/A are used preplant incorporated or preemergence for control of annual grasses and certain broadleaf weeds such as redroot pigweed, common lambsquarters and common ragweed. Use the higher rate on clay soils high in organic matter. Incorporation improved weed control with alachlor and metolachlor. Alachlor is registered as a tank mixture with atrazine, dicamba (Banvel), cyanazine, glyphosate (Roundup), paraquat and simazine. Metolachlor is registered as a tank mixture with atrazine, cyanazine, dicamba or with atrazine plus paraquat or glyphosate.

60. Propachlor (Bexton, Propachlor, Ramrod) applied preemergence at 4 to 5 lb/A controls annual grasses and some broadleaf weeds but is ineffective against wild mustard or perennial weeds. Propachlor generally has given weed control superior to alachlor and metolachlor in North Dakota State University experiments. Propachlor is registered as a tank mixture with atrazine.

61. Butylate plus R-25788 (Sutan+) at 3 to 6 lb/A preplant incorporated, controls annual grasses and some broadleaf weeds. Butylate is a volatile herbicide and must be incorporated immediately following application. R-25788 increases the tolerance of corn to butylate. Butylate generally is tank mixed with another herbicide to provide broad spectrum weed control. Butylate is

registered as a tank mixture with atrazine and cyanazine.

62. Cyanazine (Bladex) at 2 to 3.2 lb/A preemergence controls annual grasses and broadleaf weeds in corn. Cyanazine requires more than 0.5 inch of rain for activation, especially on fine textured soils. Cyanazine has a short soil residual permitting normal crop rotations. Mixtures of cyanazine with metolachlor, propachlor and alachlor improves grassy weed control. Cyanazine alone gives poor to fair redroot pigweed control. Alachlor and cyanazine are difficult to mix. For best results, premix the cyanazine as a slurry, fill the spray tank at least half full of water and while the pump and agitator are running, add the cyanazine. Once the cyanazine is completely suspended in the water, add the alachlor while filling the tank with water to the desired level. Cyanazine is registered as a tank mixture with alachlor (Lasso), atrazine (AAtrex, Atrazine), butylate (Sutan+), metolachlor (Dual) and paraquat.

63. Dicamba (Banvel) at 0.25 to 0.5 lb/A applied preemergence in tank mixtures with alachlor, metolachlor or pendimethalin gives broad spectrum weed control. The mixture is not recommended on course textured sandy soils. Use the lower rate of dicamba on medium silt loams with 2 percent or less organic matter.

64. EPTC plus R-25788 (Eradicane) at 4 to 6 lb/A controls grasses and certain broadleaf weeds. EPTC at 6 lb/A gives fair to good quackgrass control. R-25788 increases the tolerance of corn to EPTC. Soil should be dry enough and in good tilth to permit immediate and thorough incorporation. EPTC + R-25788 is registered as a tank mixture with atrazine and cyanazine.

65. Linuron (Lorox) at 0.75 to 1.5 lb/A applied preemergence controls annual broadleaf weeds and some annual grasses. Rates of linuron are dependent upon soil texture and percent organic matter. Use the low rate on sandy or low organic matter soils. Linuron is registered as a tank mixture with alachlor, atrazine and propachlor.

66. Pendimethalin (Prowl) at 1.5 to 2 lb/A controls annual grasses and certain broadleaf weeds such as redroot pigweed. Harrow if no rain occurs within seven days after application. Do not use pendimethalin on sands or loamy sands or on soils with less than 1.5 percent organic matter. Pendimethalin is registered as a tank mixture with atrazine, cyanazine and dicamba.

67. POSTEMERGENCE atrazine at 1 to 2 lb/A in combination with emulsifiable petroleum or crop origin oil gives good annual grass (inculding wild oat) control and excellent control of broadleaf weeds (including volunteer sunflower). Atrazine should be applied within three weeks after planting and when weeds are less than 1.5 inches tall. Research at North Dakota State University indicated that crop origin oils with atrazine at 1 quart per acre were more effective than 1 to 2 gallons per acre of emulsifiable petroleum oil or 1 quart per acre of petroleum oil concentrate. Surfactants and wetting agents are less effective with atrazine than any of the oil additives.

68. Cyanazine (Bladex 80W) is labeled at 1.2 to 2 lb/A with 1 quart per acre of an emulsifiable crop origin oil (Bio-Veg or Midland EV) as an early postemergence treatment for grass and broadleaf weed control (including volunteer sunflower). Only the 80W formulation is registered for postemergence weed control. Cyanazine at 1.2 lb/A with 1 quart per acre of crop origin oil has given good control of small weeds (less than 1.5 inches tall). Higher rates will give more consistent weed control but also increase the possibility of corn injury. Occasionally corn leaf burn occurs, but recovery is good. Corn should not be treated after the four-leaf stage or during extended cold, wet conditions. Cyanazine is unlikely to carry over and cause crop injury the next year. The 1.2 lb/A rate in fine textured soils only controls emerged weeds.

69. 2,4-D amine at 0.25 to 0.5 lb/A applied postemergence to corn 3 to 8 inches tall will control broadleaf weeds. 2,4-D at 0.25 lb/A will control susceptible weeds like wild mustard. The 0.5 lb/A rate will control the more resistant weeds (including volunteer sunflower), but corn may be injured. Do not use MCPA, as it is more injurious to corn than 2,4-D. When corn is over 8 inches tall, application of 2,4-D with drop nozzles reduces crop injury by avoiding treatment of upper leaves and whorl. Corn sprayed with 2,4-D may become brittle followed by bending or breaking of the stalks.

70. Dicamba (Banvel) at 0.12 to 0.25 lb/A, either alone or in a mixture with 2,4-D amine at 0.25 lb/A, can be applied postemergence in corn. Dicamba gives better control of Canada thistle, smartweed, wild buck-

wheat and volunteer sunflower than 2,4-D with less injury on corn. Dicamba can be applied until corn is 3 feet tall or until 15 days before tassel emergence, whichever comes first. Drop nozzles should be used after corn is 8 inches tall if dicamba is applied with 2,4-D.

71. Emergency control of broadleaf and grass weeds in corn can be obtained with directed applications of ametryn (Evik) or linuron (Lorox). Ametryn at 2 to 2.5 lb/A or linuron at 0.6 to 1.5 lb/A should be applied as a directed spray to the weeds. A nonionic surfactant should be used with both herbicides. Application over the top of corn will cause severe injury and contact with the leaves will cause burning. Do not apply ametryn before corn is 12 inches high and linuron before corn is 15 inches high. The weeds should not be more than 6 inches high.

72. Soybeans are poor competitors with weeds when cool soil temperatures cause slow germination and growth but are good competitors in warm soils when germination and growth are rapid. Management practices such as thorough seedbed preparation, adequate soil fertility, choice of a well-adapted variety, and use of good quality seed all contribute to a soybean crop that will compete with weeds. Soybean production requires good cultural practices. Prepare the seedbed immediately prior to planting the crop to kill germinating weeds. A rotary hoe or harrow may be used to control weeds after planting but before the soybeans emerge or once the soybeans have emerged and are 3 to 8 inches tall. Preemergence herbicides will not be inactivated by the rotary hoe or harrow. The rotary hoe is an effective and economical weed control method when the ground is not trashy, lumpy or wet and when weeds are emerging, not more than 0.25 inch tall. Cultivation is most effective when the soybeans are slightly wilted during the warm part of the day, beause the crop is less susceptible to breakage and the weeds will die quickly.

73. Most herbicides used in soybeans are labeled for tank mixing with other herbicides for broad spectrum weed control. Some of the combinations best adapted to North Dakota are given in the chemical weed control tables. Consult the label and discussion of individual herbicides for a complete listing of registered combinations.

74. Fluchloralin (Basalin), pendimethalin (Prowl), profluralin (Tolban) and trifluralin (Treflan) are dinitroaniline herbicides applied preplant incorporated for control of annual grasses and broadleaf weeds except wild mustard, common cocklebur and sunflower. Proper timing and depth of incorporation for each herbicide is essential. See the discussion concerning incorporation of the specific herbicides as requirements differ.

75. Fluchloralin (Basalin) at 0.5 to 1.5 lb/A applied preplant incorporated controls annual grasses and certain broadleaf weeds. The low rate should be used on coarse textured, sandy soils. Incorporate in the top 1.5 to 3 inches of soil within 8 hours of application. Fluchloralin is registered as a tank mixture with metribuzin.

76. Pendimethalin (Prowl) at 1.0 to 1.5 lb/A is applied preplant incorporated or preemergence to control annual grass and certain broadleaf weeds. The high rate should be used on heavy clay soils. Incorporate if rainfall does not occur within seven days after application. Pendimethalin is registered as a tank mixture with chloramben, linuron and metribuzin.

77. Profluralin (Tolban) at 0.5 to 1 lb/A preplant incorporated, controls annual grasses and certain broadleaf weeds. Profluralin should be incorporated within four hours of application with the implement set at a 4 to 6-inch depth. Delayed incorporation may result in poor weed control, especially if applied to wet, warm soil or when wind speed exceeds 10 mph. The lower rate should be used on sandy, coarse textured soils. Profluralin is registered as a tank mixture with metribuzin.

78. Trifluralin (Treflan) at 0.5 to 1 lb/A applied preplant incorporated controls annual grasses and certain broadleaf weeds. Set the implement at a 4 to 6-inch depth to uniformly disperse trifluralin into the top 2 to 3 inches. Trifluralin incorporation may be delayed up to 24 hours if applied to a cool, dry soil and if wind velocity is less than 10 mph. Do not plant soybeans deeper than 2 inches. Trifluralin is registered as a tank mixture with metribuzin and bifenox.

79. Alachlor (Lasso) and metolachlor (Dual) at 2 to 3 lb/A give good preemergence control of annual grasses and some broadleaf weeds, including redroot pigweed and common lambsquarters but are ineffective against wild mustard. Apply the higher rate on clay soils high in organic matter. Soy-

beans have good tolerance to metolachlor and alachlor and incorporation improves the consistency of weed control. Alachlor and metolachlor are registered as a tank mixture with chloramben, linuron, linuron plus paraquat, linuron plus glyphosate, metribuzin plus glyphosate and naptalam plus dinoseb. Alachlor is also registered as a tank mixture with dinoseb (Premerge).

80. Bifenox (Modown) at 1.2 to 2 lb/A applied preemergence controls certain broadleaf weeds, especially redroot pigweed. Do not use as a cracking stage treatment. Rainfall after application, especially at the time of crop emergence, may cause severe bifenox injury to the crop because treated soil is splashed onto crop plants. Bifenox is registered as a tank mixture with alachlor and trifluralin.

81. Chloramben (Amiben) at 2 to 3 lb/A is applied preemergence to control most grass and broadleaf weeds, including wild mustard. At least 0.5 inch of rain is necessary within 10 days after application for effective weed control. Excessive rainfall on light soils may leach chloramben below the level of germinating weed seeds, resulting in poor weed control and/or crop injury. Research at North Dakota State University indicated that incorporation of chloramben with trifluralin (Treflan) improved the consistency of wild mustard control compared to an application of chloramben on trifluralin overlay. Chloramben is registered as a tank mixture with alachlor, dinoseb, linuron, metolachlor, metribuzin, pendimethalin and trifluralin.

82. Linuron (Lorox) at 0.5 to 1.5 lb/A applied preemergence controls most annual broadleaf weeds. Weed control and crop injury with linuron are greatly influenced by soil texture and organic matter. Linuron is most effective on coarse textured low organic matter soils. Use rates recommended on the label for various soil types. Linuron should be used in combination because rates of linuron needed for grass control often cause soybean injury. Linuron is registered as a tank mixture with alachlor, chloramben, pendimethalin and propachlor (only on soybeans grown for seed).

83. Metribuzin (Sencor, Lexone) at 0.25 to 0.37 lb/A controls annual broadleaf weeds, especially wild mustard. The **rate is critical**. Consult the label for the proper rate based on soil type, pH, and percent organic matter. Do not apply to sandy soils. Do not use on soil with pH 7.5 or higher. Altona and Vansoy soybeans are susceptible to metribuzin. Seed soybeans 1.5 to 2 inches below the soil surface to reduce possible injury. Soybean injury also can be reduced by using herbicide combinations with lower rates of metribuzin. Metribuzin is registered as a tank mixture with alachlor, fluchloralin, metolachlor, alachlor plus paraquat, paraquat, pendimethalin, profluralin, and trifluralin.

84. Acifluorfen (Blazer) at 0.37 to 0.5 lb/A postemergence controls many broadleaf weeds. The low rate will control wild mustard and redroot pigweed but the high rate is needed for nightshade, smartweed and common cocklebur. Acifluorfen will not adequately control volunteer sunflower. Acifluorfen kills primarily by contact action, thus for effective control, applications should be to actively growing 1 to 4-inch weeds and first to second trifoliolate soybeans. Soybeans beyond the 3rd trifoliate leaf stage may intercept the spray pattern and prevent spray coverage on the weeds. Application should be made by ground sprayer delivering a minimum of 20 gallons per acre at 40 psi. Do not make application during periods of moisture stress, frosts, flooding, wind damage or unseasonably cool or hot temperatures as weed control may be reduced or crop injury increased. Best results are obtained with applications at maximum daytime temperatures of 70 to 85 F. Do not apply if rain is expected within six hours after application as weed control is reduced. Surfactants, drift control agents, liquid fertilizers, and other pesticides should not be mixed with acifluorfen. Do not apply within 50 days of harvest or use treated plants for feed or forage.

85. Bentazon (Basagran) at 0.75 to 1.5 lb/A postemergence controls many broadleaf weeds. Redroot pigweed and common lambsquarters are quite resistent, but 1 lb/A applied with a surfactant when the weeds are small (less than 1.5 inches) has given fair control on occasion. In North Dakota good wild mustard control has been obtained with 0.5 lb/A when wild mustard is small (less than 4 inches tall) and when used with an additive (see label for list of additives). For volunteer sunflower control, apply 0.75 lb/A to plants less than 5 inches and 1.0 lb/A to plants 5 to 8 inches tall. Soybean leaf burn occurs occasionally from bentazon application, but recovery is good. For Canada thistle control apply 0.75 to 1 lb/A when the plants

are 6 to 8 inches tall and, if needed, make a second application at the same rate 10 to 14 days later.

86. Dinoseb (Premerge) at 1.5 lb/A applied early postemergence to soybeans in the cracking to crook stage has controlled wild mustard. Dinoseb has been an effective supplement to preemergence herbicides which give poor wild mustard control. Application at the cracking stage kills emerged weeds and may provide some residual control of wild mustard that emerges shortly thereafter. Dinoseb kills weeds rapidly and is more effective at temperatures above 75 F.

87. Dinsoseb plus naptalam (Dyanap) at 0.5 to 1 plus 1 to 2 lb/A may be applied after the second trifoliate leaf stage but before soybeans reach 20 inches. Weeds 3 inches tall or less are most susceptible. However, weeds 3 to 6 inches tall may be controlled with the maximum rate. Research at North Dakota State University has indicated that volunteer sunflower 10 to 12 inches tall has been controlled. Applications should be made in 8 to 10 gallons per acre water by ground with 60 to 70 psi spray pressure and in at least 5 gallons per acre water by air. A ground spray boom should be 3 feet above the soybean tops and an airplane boom should be 10 to 15 feet high. Application should not be made to wet foliage. Do not use a surfactant.

DRY, EDIBLE BEANS

88. See discussion under soybeans for use of bentazon (Basagran), paragraph 85; chloramben (Amiben), paragraph 81; dinoseb (Premerge), paragraph 86; profluralin (Tolban), paragraph 77; and trifluralin (Treflan), paragraph 78. The rate of bentazon in dry beans should not exceed 1.0 lb/A. Alachlor at 2 to 3 lb/A preplant incorporated controls annual grasses and some broadleaf weeds.

89. EPTC (Eptam) at 1.5 lb/A plus trifluralin (Treflan) at 0.5 lb/A is a tank mixture to control a broader spectrum of weeds than possible with either herbicide used separately. The mixture enhances control of wild oats and black nightshade and reduces the chance of trifluralin carryover. The EPTC-trifluralin mixture must be incorporated thoroughly into the top 2 to 3 inches of soil immediately after application by setting the implement at a 4 to 6-inch depth. Do not use this combination in soybeans.

90. Navy beans generally have less tolerance to herbicides than other dry beans or soybeans. **Caution:** Use lower rates of herbicides on navy beans than other beans unless prior experience or research has shown the higher rates to be safe.

LENTILS

91. Lentils are poor competitors with weeds in the early seedling stage. Small weeds can be controlled by harrowing before crop emergence and when plants are 3 to 7 inches high.

92. Triallate (Far-go) at 1.25 lb/A or diallate (Avadex) at 1.5 lb/A can be applied for wild oat control before and after seeding lentils. Diallate and triallate are both volatile and must be incorporated into the soil immediately after application.

93. Propham (ChemHoe) applied preplant incorporated at 4 lb/A will control wild oats and volunteer grains. Lentils should be planted not later than 1 or 2 days after propham incorporation with an implement set 4 inches deep.

94. Barban (Carbyne) applied postemergence to lentils at 0.37 lb/A will control wild oats. Application should be made when wild oat seedlings are in the 1½ to 2 leaf stage and within 30 days after lentil emergence. Do not allow livestock to graze treated fields until after harvest.

SUNFLOWER

95. Weeds usually are a problem as sunflower does not develop ground cover rapidly enough to prevent weeds from becoming established. Since weeds generally emerge before the sunflower, cultivating with a spiketooth or coil spring harrow about 1 week after sowing but prior to germination of the crop will kill many weeds. After sunflower reaches the four to six-leaf stage, weeds may be controlled in the row by using a harrow or rotary hoe. Cultivation will control weeds between the rows.

96. EPTC (Eptam), profluralin (Tolban) and trifluralin (Treflan) are preplant incorporated herbicides. See paragraphs 7 to 12 for discussion on herbicide incorporation. Profluralin and trifluralin are applied on sandy soil at 0.5 lb/A and at 1 lb/A on clay soil. EPTC should be applied and incorporated immediately to prevent herbicide loss. EPTC is registered at 3 lb/A for sunflower but this rate occasionally has caused sunflower injury on coarse tex-

tured, low organic matter soils. The risk of sunflower injury from EPTC can be reduced on these soils by using 2 to 2.5 lb/A. EPTC has given more effective control of wild oats in sunflower than profluralin and trifluralin.

97. Chloramben (Amiben) at 2 to 3 lb/A preemergence controls most grass and broadleaf weeds, including wild mustard. At least 0.5 inch of rain is necessary within 10 days after application for effective weed control. Excessive rainfall on light soils may leach chloramben below the level of germinating weed seeds, resulting in poor weed control and/or crop injury. Research at North Dakota State University indicated that incorporation of chloramben with trifluralin (Treflan) improved the consistency of wild mustard control compared to an application of chloramben overlay on trifluralin.

98. Barban (Carbyne) for wild oat control is discussed in paragraphs 116 to 118.

SUGARBEETS

99 Herbicides may be used in sugarbeets to supplement cultural practices. Hand labor, mostly hoeing, may be needed for optimum weed control but can be reduced or eliminated by timely cultivations and herbicide applications. Herbicides not in the sugarbeet narrative are discussed in the table.

100. Herbicides are commonly used as tank mixtures on sugarbeets. Some herbicide combinations such as pyrazon (Pyramin) plus TCA and desmedipham plus phenmedipham (Betanal plus Betanex) are registered for use as tank mix combinations, but many other tank mixes are not registered. Herbicides may be tank mixed legally if all herbicides in the mixture are registered for use on sugarbeets. However, the user must assume liability for any resulting crop injury, inadequate weed control, or illegal and/or harmful residues.

101. EPTC (Eptam) preplant incorporated in the spring at 2 to 3 lb/A or in the fall at 4 to 4.5 lb/A gives good control of annual grasses and certain broadleaf weeds. EPTC sometimes causes a sugarbeet stand reduction and temporary stunting, however, if enough sugarbeets remain to obtain an adequate plant population after thinning, no yield reduction will result. Use EPTC with extreme caution on sugarbeets grown in sandy loam or lighter soils with low organic matter levels because predicting a safe rate on such soils is difficult. See paragraph 16 on the soil organic matter test. Herbicides such as TCA, diallate (Avadex), cycloate (Ro-Neet), ethofumesate (Norton) or pyrazon (Pyramin) plus TCA cause less sugarbeet injury on the low organic matter soils where EPTC injury may be excessive.

102. The nonregistered herbicide combination most commonly used in North Dakota and Minnesota is EPTC plus diallate (Eptam plus Avadex). Research at North Dakota State University indicated that diallate at 1 lb/A combined with EPTC should give adequate wild oat control. The rate of EPTC to combine with diallate depends on soil organic matter and time of application. EPTC plus diallate at 4 plus 1 lb/A is the most common rate for fall application. The EPTC plus diallate rate could be reduced to 3.5 plus 1 lb/A on low organic matter soils where injury from fall-applied EPTC may be excessive. EPTC plus diallate spring applied at 2 plus 1 lb/A has been quite safe and effective on most soils. However, severe sugarbeet injury can occur on coarse textured soils, especially soils with less than 4 percent organic matter.

103. TCA at 4.7 to 7.1 lb/A gives good control of green and yellow foxtail. Research has indicated that shallow incorporation generally will not reduce the weed control from TCA and under low rainfall conditions will improve weed control. TCA and diallate as a tank mixture can be applied with shallow incorporation for wild oat and foxtail control. Incorporation may reduce grass control from TCA if excessive rain follows application especially on the more coarse textured soils. TCA should not be incorporated on low organic matter, coarse textured soils where injury to sugarbeets is possible. Research results have demonstrated that TCA used in combination with or over the top of EPTC often gives improved grass and broadleaf control compared to either herbicide alone. TCA plus EPTC should only be used on higher organic matter, fine textured soils since the combination has greater injury potential than either herbicide alone.

104. Endothall (Herbicide 273) at 0.75 to 1.5 lb/A gives good postemergence control of wild buckwheat, smartweed and marshelder. Endothall should be applied when temperatures are between 60 and 80 F. Dalapon is often combined with endothall to give an-

nual grass control. Endothall plus dalapon often gives more rapid grass control than dalapon alone.

105. Ethofumesate (Nortron) at 2 to 3.75 lb/A gives good control of several broadleaf and grass weeds. Ethofumesate is particularly effective on redroot pigweed and wild buckwheat but is weak on yellow foxtail. Generally ethofumesate should be used with a herbicide like TCA, cycloate (Ro-Neet) or fall-applied EPTC for improved grass control. Ethofumesate is not registered for fall application so ethofumesate would be used as a spring overlay to fall-applied EPTC. Ethofumesate may be applied preemergence but research results in North Dakota and Minnesota have shown incorporation improved weed control. Tillage at 2 to 4 inches gave slightly better weed control compared to 1 inch. Band application of ethofumesate reduces cost and soil residue, thus a tool for band incorporation is needed. See paragraph 33 on ethofumesate residue. Ethofumesate plus TCA has been relatively safe on sugarbeets but use of ethofumesate with cycloate or fall-applied EPTC can cause sugarbeet injury especially on coarse textured soils. Ethofumesate plus spring-applied EPTC has been especially injurious to sugarbeets and should only be used on silty clay soils with over 6 percent organic matter.

106. Desmedipham (Betanex) and phenmedipham (Betanal) are postemergence herbicides for the control of annual broadleaf weeds. To avoid possible sugarbeet injury from desmedipham and phenmedipham, several precautions should be observed: 1) The sugarbeets should have at least four true leaves before treatment. 2) Use no more than 1 lb/A following EPTC or TCA. 3) Start application late in the afternoon or early in the evening so cool temperatures follow application. 4) Do not apply if the highest temperature on the day of application exceeds 85 F. 5) Set the desired band width near the top of the sugarbeets so that the beets rather than the ground receive the proper rate. Desmedipham and phenmedipham give good control of wild mustard and common lambsquarters with desmedipham slightly better on wild mustard and phenmedipham slightly better on common lambsquarters. Desmedipham gives clearly superior control of redroot and prostrate pigweed while phenmedipham is better on kochia and wild buckwheat. Desmedipham or phenmedipham should be used alone when the target species are primarily those most susceptible to one herbicide while a tank mix of desmedipham and phenmedipham should be used when some of the target species are more susceptible to phenmedipham and other species are more susceptible to desmedipham.

107. Trifluralin (Treflan) at 0.75 lb/A or EPTC (Eptam) at 3 lb/A can be used on sugarbeets after thinning for annual grass and broadleaf weed control. Broadcast and incorporate immediately with cultivators or tillage tools adjusted to mix the herbicides thoroughly with soil in the row without damaging the sugarbeets. The crop should be clean cultivated before application since established weeds are not controlled. Late germinating weeds can become a problem in sugarbeets with early seeding or when good mositure conditions prevail well into the season.

108. Diallate (Avadex) and barban (Carbyne) for wild oat control are discussed in paragraphs 113 to 118.

LEGUME ESTABLISHMENT

109. Seedling legumes usually are poor competitors with weeds. Good management practices in preceding crops are recommended such as clean cultivation of row crops and post-harvest tillage to reduce the amount of weed seeds in the soil. Weed control for establishment of legumes when sown alone can be aided by mowing (except sweetclover) herbicides, or by seeding a companion crop.

110. EPTC (Eptam) at 2 to 3 lb/A preplant and incorporated, effectively controls annual grass and broadleaf weeds except wild mustard in alfalfa, sweetclover, alsike clover or birdsfoot trefoil. Companion grass crops or grass in a mixture will be injured by EPTC.

111. Diallate (Avadex) for wild oat control in alfalfa is discussed in paragraph 115.

WILD OATS CONTROL

112. Wild oats is difficult to control because the plants shatter their seeds before crops are harvested and because of seed dormancy which causes delayed germination. Wild oats is a cool season plant and seeds germinate in the spring and fall when favorable temperature and mositure conditions exist.

113. Diallate (Avadex) at 1.25 to 2 lb/A is applied preplant for wild oats control in flax, sugarbeets, potatoes, soybeans, forage legumes, corn, lentils or peas and after planting barley, flax, soybeans, corn, lentils or peas. Diallate is volatile and must be incorporated into the upper 2 inches of soil immediately after application to prevent losses by evaporation. See paragraph 19 for fall application of diallate.

114. Triallate (Far-go) at 1 to 1.5 lb/A is applied preplant or preemergence incorporated for wild oats control in wheat, durum, barley, peas or lentils. Triallate is volatile and must be incorporated immediately after application. The liquid formulation has given more consistent wild oat control with less crop thinning than the granular formulation when spring applied. See paragraph 21 for fall application of triallate. Triallate at 1 lb/A also may be applied in combination with trifluralin (Treflan) at 0.5 to 0.75 lb/A for both wild oat and foxtail control in wheat and durum after seeding.

115. Diallate (Avadex) at 1.25 lb/A applied preplant incorporated in the spring will control wild oats in newly seeded alfalfa. Wild oats in flax or barley underseeded with alfalfa can be controlled with preemergence incorporated diallate at 1.25 lb/A in the spring.

116. Barban (Carbyne) for postemergence control is applied when the majority of the wild oats is in the 1.5-leaf stage, which generally occurs from four to nine days after emergence. Barban at 0.25 to 0.37 lb/A is applied on spring and winter wheat, barley, flax and peas; at 0.37 lb/A on safflower, lentils, soybeans and mustard grown for oil; at 0.5 to 1 lb/A on sunflower; and 0.75 to 1 lb/A on sugarbeets. Thick, vigorous stands of crop plants help suppress wild oats and enhance the control obtained with barban. Crop competition is important for wild oat control; therefore, control may not be satisfactory in thin crop stands. Barban application is not affected by barley and wheat crop stage. Treat flax before the 12-leaf stage, and soybeans, lentils, mustard, sunflower, and sugarbeets within 30 days of crop emergence. Do not mix barban with any other hebicide because wild oat control will be reduced.

117. Barban may be mixed with 1 gallon per acre aqueous nitrogen for control of wild oats in wheat and barley. This treatment has increased wild oat control in North Dakota tests especially when the plants were growing under low fertility or drought stress. The barban-aqueous nitrogen solution must be mixed with water for application. Consult the herbicide/fertilizer combination narrative in paragraphs 25 to 26 regarding compatibility tests.

118. To reduce possible injury to wheat and barley, barban should be applied when the daytime temperature will exceed 50 F for at least several hours during each of the first three days following application. Barban is different from most herbicides since phytotoxicity is greater at lower temperatures. The higher rate should be used at temperatures about 85 F, with low fertility soil, or droughty conditions. Frost prior to barban application does not increase barban injury to wheat and barley if the wild oat leaves are not damaged by the frost and temperatures after application are greater than 50 F.

119. Difenzoquat (Avenge) is applied at 0.6 to 1 lb/A for control of wild oats at the 3 to 5-leaf stage. Difenzoquat is cleared for use in barley, durum wheat (except Lakota and Wascana), winter wheat and Butte, Era, Kitt and Olaf hard red spring wheat. Wild oats is more susceptible at the 5-leaf than the 3-leaf stage of growth and control also is improved by good crop competition. The high rate should be used on high populations of 3-leaf wild oats. Wheat injury may occur at temperatures about 80 F. Certain hard red spring wheat varieties have been nearly as susceptible to difenzoquat as wild oats, so use only for wheat varieties listed on the label. Difenzoquat may be mixed with bromoxynil, MCPA, MCPA plus bromoxynil or 2,4-D for broadleaf weed control without loss of wild oats control.

120. Diclofop (Hoelon) can be applied at 0.75 to 1.25 lb/A in wheat and 0.75 to 1 lb/A in barley for control of one to four-leaf wild oats. The higher rate of diclofop should be used to control wild oats in the three to four-leaf stage or when the plants are growing under moisture stress. Wild oats control with diclofop is best when daytime temperatures do not exceed 80 F. Diclofop should not be mixed with any broadleaf herbicide other than bromoxynil. Research results at North Dakota State University indicate that application of diclofop and broadleaf herbicides other than bromox-

ynil should be separated by four days or wild oat control with diclofop will be reduced. For additional information on control of foxtail in small grains see paragraphs 39-41.

PERENNIAL WEED CONTROL

121. PERENNIAL WEEDS IN SMALL GRAINS: Canada thistle, perennial sowthistle and field bindweed can be controlled in tolerant crops with MCPA and 2,4-D. Perennial weed control systems should include herbicide application in the crop followed by postharvest threatment for several years. When controlling thistles in small grains except oats, apply the maximum rate of 2,4-D or MCPA the crop will tolerate: 0.75 lb/A of 2,4-D or MCPA amine and 0.66 lb/A of 2,4-D low volatile ester or MCPA ester. MCPA is as effective on Canada thistle as 2,4-D but MCPA is less likely to cause injury to small grain crops than 2,4-D. Cereals more tolerant to 2,4-D such as rye, wheat and barley should be grown if high herbicide rates are planned for controlling hard-to-kill annual or perennial weeds in crops. MCPA can be used to suppress thistles in oats and flax. However, these crops do not tolerate rates of MCPA necessary to give adequate thistle control.

122. Glyphosate (Roundup) at 1.5 to 3.35 lb/A may be applied for spot treatment of perennial weeds in wheat, barley, oats, corn and soybeans. Spot treatments must be made prior to the heading stage of small grains, initial pod set on soybeans and silking of corn. Glyphosate is a nonselective postemergence herbicide so the crop in the treated area will be killed, and care must be taken to avoid drift outside the target area. Glyphosate does not have a soil residual, so plants arising from seed after treatment or unaffected underground rhizomes or roots of perennials will continue to grow. See the perennial weed control section of the tables for application stages and rates.

123. Fall herbicide treatments are more effective than spring or summer treatments for controlling perennial weeds. The optimum time of treatment usually is between August 20 and September 10, but treatments later in September can be successful if most weed stem and leaf tissue has not been killed by frost. Weeds such as field bindweed, leafy spurge and Canada thistle should have 12 inches or more of stem tissue before treatment for adequate leaf area to absorb the herbicide. Mowing or tillage is a good means of reducing perennial weed seed production but should be discontinued in mid-July to allow adequate plant regrowth by herbicide treatment time. Postharvest treatments can be used when weed growth has reached approximately one foot of stem tissue. A preharvest treatment with 2,4-D can be used in small grains after the grain matures to the dough stage or later. Herbicide treatment and swathing should be separated by at least 5 days for adequate herbicide translocation.

124. PERENNIAL WEEDS IN PASTURE: Picloram (Tordon) controls broadleaf perennial weeds such as leafy spurge, field bindweed, Canada thistle and Russian knapweed on rangelands and permanent grass pastures. Rates of 1 to 2 lb/A give excellent control of these weeds and are economical for spot treatment. Picloram at 0.25 to 0.5 lb/A postemergence will suppress the growth of perennial broadleaf weeds. Retreatment at the same rates may be necessary the following year.

125. Picloram is very toxic to many broadleaf plants so spray drift in small amounts may cause damage to sensitive plants. Dry beans, soybeans, potatoes, safflower and sunflower are highly susceptible to picloram. Picloram is water soluble and may leach in the soil; consequently, do not apply in areas with a high water table or near shelterbelts, shrubs or trees. Do not treat or allow picloram spray drift onto the inner banks or bottoms of irrigation and drainage ditches. When picloram has been applied at 1 to 2 lb/A, do not cut grass for feed within two weeks after treatment. Meat animals grazing for up to two weeks after treatment should be removed from treated areas three days prior to slaughter. Do not graze dairy animals on treated areas within two weeks after treatment.

126. 2,4-D low volatile ester at 1 to 2 lb/A can be used to control many perennial weeds in pastures. Some perennials such as fringed sagebrush and western snowberry (buckbrush) can be controlled with one application, but many perennials such as Canada thistle, field bindweed and leafy spurge require retreatment annually. 2,4-D can be used in many locations where picloram cannot be used, except 2,4-D drift onto sensitive plants such as trees should

be avoided. Dairy cows cannot be grazed on treated area for 7 days after treatment.

127. Dicamba at 0.5 to 8 lb/A can be used to control some perennial weeds, especially weeds that are resistant to 2,4-D, or for some areas where soil residual of picloram may cause problems. Dicamba at 0.5 to 1 lb/A will control some perennials but annual retreatment is required for many perennial weeds. Long-term control generally is achieved with 4 to 8 lb/A but the high rates are economical only for spot treatment. Dicamba has a shorter soil residual than picloram, but should not be applied where desirable broadleaf plants or trees may be damaged by dicamba leached to the root system. Do not graze meat animals in treated fields within 30 days of slaughter. The required delay between treatment and grazing of dairy animals or cutting for hay varies with rate from 7 to 90 days, so the label should be consulted for this information.

128. The roller applicator is a new technique of applying picloram for leafy spurge control in pastures. Research at North Dakota State University has shown that leafy spurge control was better when picloram was applied with the roller than when applied at 0.5 lb/A broadcast. Further, leafy spurge control was similar when picloram was applied either broadcast at 2 lb/A or with the roller when used as follows. The solution applied to the roller was 1 part picloram (Tordon 22K): 7 parts water, plus 0.5 to 1% non-ionic surfactant. The roller height was adjusted to treat approximately the upper half of the taller leafy spurge stems. Rotation of the roller was approximately 50 rpm in a counter-clockwise direction which lifted the weeds against the carpet while moving forward at 3 mph. The carpet on the roller was moistened until a small bead of water would form when moderate to firm pressure was applied to the carpet. Application can be made anytime after the leafy spurge is 15 to 20 inches tall until freezing temperatures occur in the fall. Actual picloram applied has been reduced by 50 to 70% when using the roller applicator in dense infestations as compared to the broadcast application at 2 pounds per acre. Greater reductions in herbicide use would occur with less dense leafy spurge infestations. Retreatments using 2,4-D at 1 to 2 lb/A may be necessary the following year to control seedlings.

CHEMICAL FALLOW AND TILLAGE SUBSTITUTE

129. Paraquat, a nonselective contact herbicide, can be used at 0.5 lb/A as a substitute for a weed controlling tillage operation when wet fields or the desire to conserve seedbed moisture make tillage impractical. Paraquat may be applied before or after planting until just before crop emergence. Apply paraquat in 5 to 10 gallons per acre of water by air or in 20 to 60 gallons per acre of water by ground. Add Ortho X-77 or other nonionic surfactant to the spray solution at 0.5 pint per 100 gallons. Paraquat can be used on land intended for barley, corn, potatoes, soybeans, sugarbeets and wheat. Paraquat is corrosive to exposed aluminum spray equipment and aircraft structures so rinse equipment immediately after use. Paraquat is toxic so avoid contact with the skin and small amounts could be fatal if swallowed.

130. Glyphosate (Roundup) is applied postemergence for annual weed control in reduced tillage situations at 0.37 to 0.75 lb/A. Glyphosate is a translocated, nonselective herbicide with no soil activity. Glyphosate at 0.37 lb/A used in combination with a non-ionic surfactant at 0.5% V/V will control downy brome, wild oats, volunteer small grain, and certain broadleaf weeds less than 6 inches tall. The 0.37 lb/A rate will not control wild buckwheat, Russian thistle, or kochia. Use the higher rate on larger weeds, more resistent weeds, or if plants are under moisture stress. Delay tillage for at least three days after treatment. Apply glyphosate at 1.5 to 2.25 lb/A when quackgrass is at least 8 inches tall (3 to 4 leaf stage) and actively growing or when Canada thistle is at least 10 inches tall and is approaching early bud stage. Fall treatment of Canada thistle must be applied before frost for best results. Do not till until three or more days after treatment. Glyphosate can be used in the spring before or after planting but before emergence of barley, corn, oats, soybeans, wheat andsorghum (milo), or in the fall when these crops will be planted the next growing season.

131. Cyanazine (Bladex) is applied preemergence at 2.4 to 3.2 lb/A to control annual weeds on fallow for future planting to wheat, barley, oats, sorghum or corn. Cyanazine is a short residual herbicide so

carryover to succeeding crops is unlikely. Rainfall is required for activation of cyanazine. Generally 0.5 inch will be adequate if the soil is wet to a depth of 1.5 to 2 inches. Whenever possible, cyanazine should be applied at a time when rainfall can be expected within about 10 days. A late fall application about two weeks ahead of expected soil freeze-up will result in adequate control of early germinating weeds the following spring. Spring applications of cyanazine should be made as soon as practical after the soil thaws to take advantage of early spring rains for activation and to move the herbicide in the soil before weeds germinate. If winter annual or annual weeds have emerged, a tank mix of paraquat and cyanazine should be applied because cyanazine does not adequately control emerged weeds.

132. A tank mixture of cyanazine at 2 to 2.8 lb/A plus atrazine at 0.4 to 0.5 lb/A is labeled in North Dakota for annual weed control on fallow. Soils with 3 to 4 percent organic matter require the high rate of cyanazine. The cyanazine plus atrazine combination gives increased residual weed control compared to cyanazine alone. The tank mix combination must be applied before November 15 of the year preceding the planting of winter wheat. Atrazine preemergence at 0.5 to 1 lb/A will control annual weeds including downy brome (Cheatgrass) during the fallow period of a wheat-fallow-wheat rotation. See tables for restrictions on atrazine use. Allow 12 or more months between application and planting. If weeds are emerged but less than 6 inches tall at application, a tank mixture of atrazine with paraquat or terbutryn (Igran) should be applied. A nonionic surfactant should be added to both mixtures.

133. Propham (Chem Hoe 135) can be applied at 3 to 4 lb/A for control of downy brome, wild oats and volunteer grain in fallow. The higher rate of application is for use on medium and fine textured soils. Propham should be applied in the fall after soil temperatures have cooled to 50 F or cooler in the upper inch of soil. The lower temperature reduces herbicide loss by volatility and degradation by soil microbes. Precipitation after propham application is necessary for effective weed control.

CHEMICAL WEED CONTROL
For Field Crops

Wheat, Durum or Barley

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Paraquat	0.5 (1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or anytime prior to crop emergence	A nonselective, postemergence herbicide. No soil residual activity. Apply with X-77 or other nonionic surfactant. Good coverage is essential.	129
Glyphosate **(Roundup)**	0.375 to 0.75 (1 pt to 1 qt)			A nonselective, translocated, postemergence herbicide. No soil residual activity. Use lower rate for annual grasses.	130
2,4-D amine 2,4-D L.V. ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf	Crops—5th leaf and prior to boot	Do not apply from early boot to dough stage. Barley more susceptible than wheat. Use 0.5 lb/A for volunteer sunflowers and kochia.	34,38, 44,45, 46
MCPA amine MCPA ester	0.25 to 0.66 (0.5 to 1.33 pt. of 4 lb/gal conc.)		Crops—emergence and prior to boot	Apply 0.25 to 0.5 lb/A from emergence to tiller stage. Use 0.5 lb/A for volunteer sunflowers and kochia	34,38 44,45, 46

Table Continued . . .

*Formulation values are given for the most commonly used products and not included for most mixtures because of inadequate space. To calculate the amount of formulation needed for a specific rate of active ingredient, see page 1.
**Reference paragraph number indicates appropriate paragraph in the narrative.

Wheat, Durum or Barley (continued)

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Bromoxynil **(Brominal, Buctril)** + MCPA ester	0.25 + 0.25 (1 pt + 0.5 pt of 4 lb/gal MCPA)	Wild buckwheat, volunteer sunflowers, and most broadleaf weeds	Crops—3rd leaf and prior to boot	Apply when weeds are in early seedling stage for best results. Commercial mistures (Brominal Plus & Bronate) are available. Volunteer sunflower control better than 0.5 lb/A of 2,4-D	37,44, 45,46
Picloram (Tordon 22K) + 2,4-D or MCPA	1/64 + 0.25 to 0.37 (1 fl. oz + 0.5 to 0.75 pt of 4 lb/gal conc.)	Wild buckwheat and most broadleaf weeds	Crops—3rd through 5th leaf stage	Use only on land to be planted the following year to grass, small grains, corn, sorghum or flax.	31,36, 44,45, 46
Barban **(Carbyne)**	0.25 to 0.37 lb. (2 to 3 pt)	Wild oats	Wild oats in 2-leaf stage	Wild oats usually develops to the 2-leaf stage between 4 and 9 days after emergence. Do not mix barban with any other herbicide. Wild oat control improves with the addition of 1 gal/A of aqueous nitrogen fertilizer.	116, 117, 118
Difenzoquat **(Avenge)**	0.62 to 1 lb (2.5 to 4 pt)	Wild oats	3 to 5 leaf stage of wild oats	Cleared on barley, durum (except Lakota and Wascana) Butte, Era, Kitt and Olaf wheat. Use high rate on high populations of 3-leaf wild oats. Can be applied with 2,4-D, MCPA amine, bromoxynil or MCPA plus bromoxynil. Injury may occur when crop is under environmental stress.	119

Wheat or Durum

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Triallate **(Far-go)**	1 lb (1 qt)	Wild oats	Spring—immediately after planting	Apply on smooth soil surface and incorporate immediately in top 2 inches by cultivation. Wheat must be below the incorporated zone.	13, 114
	1 lb liquid (1 qt) 1.25 to 1.5 lb granules (12.5 to 15 lb 10G		Fall—after October 15 and until freeze-up	Keep spring tillage depth to minimum. Lower rate has generally given adequate control.	13, 21
Triallate **(Far-go)** + Trifluralin **(Treflan)**	1 lb (1 qt) + 0.5 (1 pt)	Wild oats and foxtails (pigeongrass)	In spring—immediately after planting.	Plant wheat 2 to 2.5 inches deep. Incorporate herbicide shallowly twice with flex-tyne or diamond harrows to depth of 1 to 1.5 inches.	13, 114
Trifluralin **(Treflan)**	0.5 to 0.75 (1 to 1.5 pt)	Foxtails (pigeongrass)			13
Dicamba **(Banvel)** + MCPA amine	0.06 to 0.12 + 0.25 to 0.38 (0.12 to 0.25 pt + 0.5 to 0.75 pt)	Wild buckwheat and most broadleaf weeds	Crops—2nd through 4th leaf stage	Commercial mixture. (Mondak, 1.25 lb dicamba + 2.5 lb MCPA per gallon). Use less dicamba and more MCPA on larger wheat.	35,44, 45,46

Table Continued . . .

*Formulation values are given for the most commonly used products and not included for most mixtures because of inadequate space. To calculate the amount of formulation needed for a specific rate of active ingredient, see page 1.

**Reference paragraph number indicates appropriate paragraph in the narrative.

Wheat or Durum (continued)

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Dicamba (**Banvel**) + 2,4-D amine	0.06 + 0.25 (0.12 pt + 0.5 pt)	Wild buckwheat and most broadleaf weeds	Crop—4 leaf stage	Proper timing of application is important to avoid crop injury.	35
Diclofop (**Hoelon**)	0.75 to 1.25 (2 to 3.3 pt)	Wild oats and foxtail	Grass weeds—1 to 4 leaves	Use higher rates for dry conditions or grass weeds with 3 to 4 leaves. Do not mix with any herbicide except bromoxynil.	120

Barley

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Diclofop (**Hoelon**)	0.75 to 1 (2 to 2.7 pt)	Wild oats and foxtail	Grass weeds—1 to 4 leaves	Use higher rate for dry conditions on grass weeds with 3 to 4 leaves. Do not mix with any herbicide except bromoxynil.	120
Triallate (**Far-go**)	1.25 lb (1.25 qt)	Wild oats	Spring—before or after planting	Apply on smooth soil surface and incorporate immediately in top 2 inches by cultivation.	8,13, 114
	1.25 lb liquid (1.25 qt) 1.25 to 1.5 lb granules (12.5 to 15 lb 10G)		Fall—after October 15 and until freeze-up	Keep spring tillage to minimum. The lower rate has generally given adequate control.	8,13, 21
Diallate (**Avadex**)	1.25 lb (1.25 qt)		Spring—after planting	Apply on smooth soil surface and incorporate immediately in top 2 inches by cultivation.	8,13, 113
			Fall—after October 15 and until freeze-up	Keep spring tillage depth to minimum.	13,19
Trifluralin (**Treflan**)	0.5-0.75 (1 to 1.5 pt)	Foxtails (Pigeongrass)	Spring—after planting		

Spring Wheat

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Propanil (**Stampede**)	1.12 to 1.5 lb/A (3 to 4 pts)	Green and yellow foxtail and certain annual broadleaf weeds	Weeds—2 to 4 leaf, crop—2nd through 4th leaf	Application to foxtail larger than 3 leaves or wheat larger than 4 leaves may result in reduced weed control or increased wheat injury.	41

Winter Wheat

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Glyphosate (**Roundup**)	0.375 to 0.75 (1 pt to 1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or anytime prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Use lower rate for annual grasses.	130
Triallate (**Far-go**)	1.25 (1.25 qt)	Wild oats	Before or after seeding	Before seeding—incorporate with duckfoot cultivator to depth of 2 inches or less followed by spiketooth harrow.	21

Table Continued . . .

*Formulation values are given for the most commonly used products and not included for most mixtures because of inadequate space. To calculate the amount of formulation needed for a specific rate of active ingredient, see page 1.

**Reference paragraph number indicates appropriate paragraph in the narrative.

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Triallate **(Far-go)** continued	1.25 (1.25 qt)	Wild oats	Before or after seeding	Seed wheat 2.5 to 3 inches deep. After seeding—plant wheat 2 to 3 inches deep and incorporate by harrowing twice.	
	1.25 to 1.5 (12.5 to 15 lb 10G)		After planting and before wild oats emerges	Incorporate after application with a harrow before wild oats germinates.	21
2,4-D amine 2,4-D L.V. ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf	In spring when wheat is well tillered but prior to early boot stage	Do not apply from early boot to dough stage. Do not apply in the fall.	34,38, 44,45, 46
MCPA amine MCPA ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)		In spring from 4-leaf stage and prior to early boot		
Dicamba **(Banvel)** + MCPA amine	0.06 to 0.12 + 0.25 to 0.38 (0.12 to 0.25 pt + 0.5 to 0.75 pt)	Wild buckwheat and most broadleaf weeds	In spring immediately after winter dormancy before wheat begins to joint	Commercial mixture is available. do not apply in the fall.	35,44, 45,46
Dicamba **(Banvel)** + 2,4-D amine	0.06 + 0.25 (0.12 pt + 0.5 pt)	Wild buckwheat and most broadleaf weeds		Do not apply in the fall.	35
Bromoxynil **(Brominal, Buctril)** + MCPA ester	0.25 + 0.25 (1 pt + 0.5 pt of 4 lb/gal MCPA)	Wild buckwheat, volunteer sunflowers, and most broadleaf weeds	In spring prior to boot stage	Apply while weeds are small and before they are shaded by the crop. Do not apply in the fall. Commecial mixtures (Brominal Plus & Bronate) are available.	37,43, 45,46
Picloram (Tordon 22K) + 2,4-D or MCPA	1/64 + 0.25 to 0.37 (1fl. oz + 0.5 to 0.75 pt of 4 lb/gal conc.)	Wild buckwheat and most broadleaf weeds	In spring after resumption of active crop growth and before early boot stage	Do not apply in the fall. Use only on land to be planted the following year to grass, small grains, corn, sorghum or flax.	31,36, 44,45, 46
Barban **(Carbyne)**	0.25 to 0.37 lb (2 to 3 pt)	Wild oats	Wild oats in 2-leaf stage. Crop stage is not applicable	Wild oats usually develops to the 2-leaf stage between 4 and 9 days after emergence. Do not mix barban with any other herbicide. Wild oat control improves with the addition of 1 gal/A of aqueous nitrogen fertilizer.	116, 117, 118
Diclofop **(Hoelon)**	0.75 to 1.25 (2 to 3.3 pt)	Wild oats and foxtail	Grass weeds—1 to 4 leaves	Use higher rates for dry conditions or grass weeds with 3 to 4 leaves. Do not mix with any herbicide except bromoxynil.	120
Difenzoquat **(Avenge)**	0.62 to 1 lb (2.5 to 4 pt)	Wild oats	3 to 5 leaf stage of wild oats	Use high rate on high populations of 3-leaf stage wild oats. Can be applied with 2,4-D, MCPA amine, bromoxynil, or MCPA plus bromoxynil. Injury may occur when crop is under environmental stress.	119

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Rye

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
2,4-D amine 2,4-D L.V. ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf	In spring when rye is well tillered but prior to early boot stage	Do not apply from early boot to dough stage. Do not apply in the fall.	34,38, 44,45, 46
MCPA amine MCPA ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)		In spring from 4-leaf stage and prior to early boot		
Bromoxynil **(Brominal, Buctril)**	0.25 to 0.5 (1 to 2 pt)	Wild buckwheat and other broadleaf weeds	In spring prior to early boot stage	Apply while weeds are small and before they are shaded by the crop. Do	37,43,
Bromoxnil **(Brominal, Buctril)** + MCPA ester	0.25 + 0.25 (1 pt + 0.5 pt of 4 lb/gal MCPA)			Do not apply in the fall. Commercial mixtures (Brominal Plus & Bronate) are available.	45,46

Oats

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Glyphosate **(Roundup)**	0.375 to 0.75 (1 pt to 1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or anytime prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Use lower rate for annual grasses.	130
MCPA amine MCPA ester	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf	Oats—emergence to boot	Early jointing stage most susceptible. Possible injury to oats at any growth stage. Use 0.5 lb/A for volunteer sunflowers.	34,38, 44,45, 46
Bromoxynil **(Brominal, Buctril)** + MCPA ester	0.25 + 0.25 (1 pt plus 0.5 pt of 4 lb/gal MCPA)	Wild buckwheat, volunteer sunflowers and most broadleaf weeds	Oats—3rd leaf to boot stage	Apply when weeds are in early seedling stage for best Commercial mixtures (Brominal Plus & Bronate) are available. Volunteer sunflower control better than 0.5 lb/A of 2,4-D.	37,43, 45,46
Picloram **(Tordon 22K)** + MCPA amine	1/64 + 0.25 to 0.37 (1 fl. oz + 0.5 to 0.75 pt of 4 lb/gal conc)	Wild buckwheat and most broadleaf weeds	Oats—3rd through 5th leaf stage	Use only on land to be planted the following year to grass, small grains, corn, sorghum or flax.	31,36, 44,45, 46
Dicamba **(Banvel)** + MCPA amine	0.06 to 0.12 + 0.25 to 0.38 (0.12 to 0.25 pt + 0.5 to 0.75 pt)		Oats—2nd through 4th leaf stage	Commercial mixture is avail- (Mondak 1.25 lb dicamba + 2.5 lb MCPA). Use less dicamba and more MCPA on larger oats.	36,44, 45,46,

Small Grain Pre-Harvest
(spring wheat, winter wheat, winter rye, barley & oats)

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
2,4-D L.V. ester	0.75 to 1.5 (1.5 to 3 pt of 4 lb/gal conc.)	Broadleaf	Crops—dough stage to harvest	Use only when weeds may interfere with harvest operations. Do not feed straw to livestock. CAUTION: Drift to sunflowers is hazardous at this time.	121

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**Reference paragraph number indicates appropriate paragraph in the narrative.

Flax

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Diallate **(Avadex)**	1.5 to 2 lb (1.5 to 2 qt)	Wild oats	Preplant incorporated, fall or spring	Operating incorporation implement 4 to 6 inches deep does not reduce wild oat control.	13,19, 113
EPTC **(Eptam)**	4 (4.5 pt 7E, 40 lb 10G)	Grasses and some broad-	Fall incorporated after October 15 until freeze-up	Flax safety is marginal. Weak on wild mustard.	10,20, 50
MCPA	0.25 (0.5 pt of 4 lb/gal conc.)	Broadleaf	Flax—2 to 6 inches tall	Use MCPA ester or higher rates of MCPA amine for hard-to-kill weeds. Early application less injurious to flax.	52
Dalapon **(Dowpon)**	0.75 (1 lb)	Annual grasses except wild oats	Best results obtained when flax is over 2 inches and weeds are under 2 inches tall	Mix MCPA with dalapon to control broadleaf and annual grassy weeds. Under drouth conditions, grass control is poor and flax injury may occur.	54
Bromoxynil **(Buctril, Brominal)**	0.25 to 0.5 (1 to 2 pt)	Wild buckwheat and certain broadleaf weeds	Flax—2 to 6 inches tall	Use for wild buckwheat control. Weak on wild mustard. Flax injury is possible.	53
Barban **(Carbyne)**	0.25 to 0.37 lb (2 to 3 pt)	Wild oats	Wild oats 2-leaf and before 12-leaf stage of crop	Wild oats usually develops to the 2-leaf stage between 4 and 9 days after emergence. Do not mix barban with any other herbicide.	116, 117, 118

Corn

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Atrazine + Butylate + R-25788 **(Sutan +)**	1 + 3	Most grasses and broadleaf weeds	Preplant incorporated	Immediate incorporation is needed for best results. R-25788 protects corn from injury.	8,10, 29,61
EPTC + R-25788 **(Eradicane)**	4 to 6 (4.75 to 7 pt)	Grasses and some broadleaf weeds. Weak on wild mustard.		R-25788 protects corn from injury. Immediate incorporation is needed	8,10 64
Glyphosate **(Roundup)**	0.36 to 0.75 (1 pt to 1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or anytime prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Use lower rate for annual grasses.	130
Paraquat	0.5 (1 qt)			A nonselective, contact postemergence herbicide. No soil residual activity. Apply with X-77 or non-ionic surfactant. Good coverage is essential.	129
Alachlor **(Lasso)**	2 to 3 (2 to 3 qt)	Grasses and some broadleaf weeds	Preplant incorporated or preemergence	Wild mustard control not adequate. Usually less effective preemergence than propachlor in North Dakota. Preplant incorporation gives more consistent weed control.	8,59
Metolachlor **(Dual)**	2 to 3 (2 to 3 pt)				

Table Continued . . .

*Formulation values are given for the most commonly used products and not included for most mixtures because of inadequate space. To calculate the amount of formulation needed for a specific rate of active ingredient, see page 1.
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Corn (continued)

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Atrazine	2 to 4 (2 to 4 qt 4L, 2.5 to 5 lb 80W)	Broadleaf and grasses	Preplant incorporated or preemergence	Use higher rate on fine textured soils for quackgrass and Canada thistle control.	29,58
Diallate **(Avadex)**	1.5 lb (1.5 qt)	Wild oats	Preplant or preemergence incorporated	Operating incorporation implement 4 inches deep does not reduce wild oats control.	8,13, 113
Atrazine + Alachlor **(Lasso)**	1 + 2	Most grasses and broadleaf weeds	Preplant incorporated or preemergence	Do not harvest for silage within 12 weeks of application.	8,29 58,59
Atrazine + Metolachlor **(Dual)**	1.5 to 2 + 1 to 2.4 (1.5 to 2 pt + 1.25 to 3 lb 80W)			Atrazine carryover may be a problem with rates used in the mixture. Commercial mix available (Bicep, ratio 2 lb metolachlor to 2.5 lb atrazine).	29,58 59
Atrazine + Propachlor	1 + 3 (tank mix)	Broadleaf and annual grasses	Preemergence	Commercial mixture is available (ratio 1 lb atrazine to 2.3 lb propachlor).	29,58, 60
Cyanazine **(Bladex)**	2 to 3.2 (2.5 to 4 lb 80W) 2 to 3.2 qt 4WDS)			Soil residues unlikely the year after treatment. Weak on redroot pigweed. Use higher rate on fine textured soil.	62
Cyanazine **(Bladex)** Alachlor **(Lasso)**	1 to 2 + 2	Most grasses and broadleaf weeds		Use lower rate of cyanazine on coarse textured soils.	59,62
Dicamba **(Banvel)** + Alachlor **(Lasso)**	0.25 to 0.5 + 2	Broadleaf and annual grasses		Use lower rate of dicamba on coarse textured soils.	59,63
Linuron **(Lorox)** + Alachlor **(Lasso)**	0.75 to 1 + 1.5 to 2.5	Broadleaf and annual grasses	Preemergence	Use only on medium to coarse textured soils. Use lower rate on coarse textured soils. Soil residues unlikely the year after treatment.	59,65
Linuron **(Lorox)** + Propachlor	0.75 to 1.5 + 3				60,65
Pendimethalin **(Prowl)**	1.5 to 2 (3 to 4 pt)	Grasses and some broadleaf weeds	Preemergence	Do not use on sands or loamy sands. Use higher rate on fine textured soils high in organic matter. Do not incorporate.	66
Pendimethalin **(Prowl)** + Cyanazine **(Bladex)**	1 to 1.5 + 1.6 to 2 (2 to 3 pt + 2 to 2.5 80W)	Most grasses and broadleaf weeds		User can rotate from corn to other crops. Use lower rate of cyanazine on coarse textured soils.	62,66
Propachlor	4 to 5 (6 to 8 lb 65W)	Grasses and some broadleaf weeds	Preemergence	Ineffective against wild mustard.	60
Atrazine + phytobland oil	1 to 2 + a phytobland oil	Broadleaf and grasses	Early postemergence—weeds less than 1.5 inches tall	Use emulsifiable crop origin oil (linseed or soybean) or petroleum oils at volume recommended on label.	29,67
Cyanazine **(Bladex 80W)** + crop origin oil	1.2 + 1 qt crop origin oil (1.5 lb 80W)		Weeds less than 1.5 inches and corn 4 leaf stage or smaller	Use emulsifiable crop origin oil (linseed or soybean). Use only Bladex 80W for postemergence applications.	68

Table Continued . . .

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Corn (continued)

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Dicamba **(Banvel)**	0.12 to 0.25 (0.25 to 0.5 pt)	Wild buckwheat, Canada thistle, P. sowthistle	Postemergence, before corn is 36 inches tall	Use drop nozzles after corn is 8 inches tall to reduce drift. Apply at least 15 days before tasseling to avoid sterility.	70
2,4-D amine	0.25 to 0.5 (0.5 to 1 pt of 4 lb/gal conc.)	Broadleaf weeds	Postemergence, corn—3 inches to tasseling	Use drop nozzles when corn is over 8 inches tall but before tasseling. Dicamba can be mixed with 0.25 lb of 2,4-D.	69

Soybeans

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Glyphosate **(Roundup)**	0.37 to 0.75 (1 pt to 1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or anytime prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Use lower rate for annual grassy weeds.	130
Paraquat	0.5 (1 qt)			A nonselective, postemergence herbicide. No soil residual activity. Apply with X-77 or other nonionic surfactant. Good coverage is essential.	129
Diallate **(Avadex)**	1.5 to 2 lb (1.5 to 2 qt)	Wild oats	Preplant or preemergence incorporated	Operating incorporation implement 4 inches deep does not reduce wild oats control.	8,13, 113
Pendimethalin **(Prowl)**	1 to 1.5 (2 to 3 pt)	Grasses and some broadleaf weeds	Preplant incorporated	Mechanical incorporation is not required if 0.25 inch rain occurs within 7 days after application. Weak on wild mustard.	8,14, 76
Profluralin **(Tolban)**	0.5 to 1 (1 to 2 pt)			No wild mustard control.	8,10. 30,77
Fluchloralin **(Basalin)**	0.5 to 1.5 (1 to 3 pt)		Preplant incorporated (1½ to 3 inches)		8,10, 30,75
Trifluralin **(Treflan)**	0.5 to 1 (1 to 2 pt) (10 to 20G)		Preplant incorporated, fall or spring		8,10, 22,30 78
Metribuzin **(Sencor, Lexone)** + dinitroanilines	0.25 (0.5 lb WP, 0.5 pt F, 0.33 lb DF) + appropriate rate for soil type	Grasses and broadleaf weeds including wild mustard	Preplant incorporated	Dinitroanilines include fluchloralin, pendimethalin, profluralin and trifluralin. Do not use on soil with pH 7.5 or higher.	8,10, 30,32, 78,83
	0.25 to 0.37 + appropriate rate for soil type		Dinitroaniline preplant incorporated, metribuzin preemergence		
Trifluralin **(Treflan)** + Chloramben **(Amiben)**	0.75 (1.5 pt) + 2 (8 pt)	Grasses and broadleaf weeds	Preplant incorporated	Incorporation of chloramben improves wild mustard control	8,10, 30,78, 81

Table Continued . . .

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Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Alachlor **(Lasso)**	2 to 3 (2 to 3 qt)	Grasses and some broadleaf weeds	Preplant incorporated or preemergence	Wild mustard control not adequate. Preplant incorporation gives more consistent weed control. Use higher rate on fine textured soils high in organic matter.	8,79
Metolachlor **(Dual)**	2 to 3 (2 to 3 pt)				
Alachlor **(Lasso)** + Metribuzin **(Sencor, Lexone)**	2 + 0.25 to 0.37	Broadleaf weeds including wild mustard and annual grasses		Use lower rate of metribuzin on coarse textured soils and for incorporation.	8,32, 79,83
Metolachlor **(Dual)** + Metribuzin **(Sencor, Lexone)**					
Bifenox **(Modown)** + Alachlor **(Lasso)**	1.2 to 1.6 + 2 to 2.5 (1.5 to 2 80W or 1.25 to 1.5 qt + 2 to 2.5 qt)	Pigweed and other broadleaf and grass weeds	Preemergence	Injury has been observed under wet conditions, however, crop recovers and yield was not affected. Wild mustard control is variable.	79,80
Chloramben **(Amiben)**	2 to 3 (4 to 6 qt)	Grasses and broadleaf weeds		Wild oat control not adequate.	81
Linuron **(Lorox)** + Alachlor **(Lasso)**	1 + 2			Use only on sandy loam soil with 0.5 to 2% organic matter.	80,82
Dinoseb amine salt **(Premerge)**	1.5 (2 qt)	Wild mustard	Cracking to crook stage	Used primarily to supplement herbicides weak on wild mustard.	86
Dinoseb + Natalam **(Dyanap)**	0.5 to 1 + 1 to 2 (2 to 4 qt)	Annual broadleaf weeds including volunteer sunflower	After 2nd trifoliate, before 20 inch height	Treat when weeds are small. See narrative for more details.	87
Acifluorfen **(Blazer)**	0.37 to 0.5 lb (1.5 to 2 pt)	Broadleaf weeds	Postemergence Soybeans—1 to 2 trifoliate leaf stage. Weeds—1 to 4 inches tall	Weak on volunteer sunflower. Low rate will control wild mustard and redroot pigweed, high rate needed for other weeds. Apply when daytime temperatures exceed 70F.	
Bentazon **(Basagran)**	0.75 to 1.5 (0.75 to 1.5 qt)	Wild mustard, cocklebur, Canada thistle, wild and volunteer sunflower	Postemergence when mustard is in 4 to 6 leaf stage and thistle is 6 to 8 inches tall. See label for more details	Thoroughly cover weeds with spray. Do not apply during unfavorable conditions such as drought, cold or hail damage. Split application needed for Canada thistle control.	85
Barban **(Carbyne)**	0.37 lb (3 pt)	Wild oats	Wild oats 2-leaf and within 30 days of crop emergence	Wild oats usually develops to the 2-leaf stage between 4 and 9 days after emergence. Do not mix barban with any other herbicide.	116, 117 118
Paraquat	0.25 (1 pt)	Desiccant	Prior to harvest	Make applications when beans are fully developed and half of leaves have dropped and remaining leaves are turning yellow.	

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Dry Edible Beans

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Glyphosate **(Roundup)**	0.37 to 0.75 (1 pt to 1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or anytime prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Use lower rate for annual grasses.	130
Alachlor **(Lasso)**	2 to 3 (2 to 3 qt)	Grasses and some broadleaf weeds	Preplant incorporated	Wild mustard control not adequate. Use higher rate on fine textured soils high in organic matter.	8,79
EPTC **(Eptam)**	3 (1.75 qt)			Weak on wild mustard	7 to 11 16.18.
	4 to 4.5 (4.5 to 5.25 pt 7E, 40-45 lb 10G)		Fall incorporated after October 15 until freeze-up		20,89
Profluralin **(Tolban)**	0.5 to 1 (1 to 2 pt)		Preplant incorporated	No wild mustard control.	7 to 11 27 to 30
Trifluralin **(Treflan)**	0.5 to 1 (1 to 2 pt) (10 to 20 lb 5G)		Preplant incorporated, fall or spring		7 to 11 22,27 to 30, 89
Trifluralin **Treflan)** + EPTC **(Eptam)**	0.5 + 1.5 (1 pt + 1.75 pt)		Preplant incorporated	Enhances wild oat control and reduces potential carryover of trifluralin.	7 to 11 16,27 to 30, 89
Trifluralin **(Treflan)** + Chloramben **(Amiben)**	0.75 + 2 (1.5 pt + 8 pt)	Annual grasses and broadleaf weeds		Incorporation of chloramben improves wild mustard control.	8,10, 30,78 81
Chloramben **(Amiben)**	2 (4 qt)		Preemergence	Wild oat control not adequate.	81
Dinoseb amine salt **(Premerge)**	1.5 (2 qt)	Wild mustard	Cracking to crook stage	Used primarily to supplement herbicides weak on wild mustard.	86
Bentazon **(Basagran)**	0.75 to 1 (0.75 to 1 qt)	Wild mustard, cocklebur, Canada thistle, wild and volunteer sunflowers	Postemergence when mustard is in 4 to 6 leaf stage and sunflowers less than 8 inches tall. See label for more details.	Thoroughly cover weeds with spray. Do not apply under unfavorable conditions such as drought, cold or hail damage.	85

Lentils

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Diallate **(Avadex)**	1.5 (1.5 qt)	Wild oats	Preplant or preemergence incorporated	Operating incorporation implement 4 inches deep does not reduce wild oats control.	8,13 113, 92
Triallate **(Far-go)**	1.25 (1.25 qt)				8,13, 21,92, 114
Propham **(Chem Hoe FL4)**	4 (1 gal)	Wild oats, volunteer grain	Preplant incorporated	Operate incorporation implement 4 inches deep.	93
Barban **(Carbyne)**	0.37 (3 pt)	Wild oats	Wild oats 2-leaf and within 30 days after crop emergence	Wild oats usually develops to the 2-leaf stage between 4 and 9 days after emergence. Do not mix barban with other herbicides.	116, 117, 118, 94

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Safflower

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
EPTC (Eptam)	3 (1.75 qt)	Grasses and some broadleaf weeds	Preplant incorporated	See incorporation discussion in narrative for details. Weak on wild mustard.	7 to 11 16
Profluralin (Tolban)	0.5 to 1 (1 to 2 pt)			No wild mustard control.	7 to 11
Trifluralin (Treflan)	0.5 to 1 (1 to 2 pt, 10 to 20 lb 5G)		Preplant incorporated, fall or spring		7 to 11 16,27 to 30
Barban (Carbyne)	0.37 lb (3 pt)	Wild oats	Wild oats 2-leaf and within 30 days after emergence of crop	Wild oats usually develops to the 2-leaf stage between 4 and 9 days after emergence. Do not mix barban with any other herbicide.	116, 117, 118

Sunflower

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
EPTC (Eptam)	2 to 3 (2.3 to 3.4 pt)	Grasses and some broadleaf weeds	Preplant incorporated	Weak on wild mustard	7 to 11, 16,18, 96
	4 to 4.5 (4.5 to 5.25 pt 7E, 40 to 50 lb 10G)		Fall incorporated after October 15 until freeze-up		
Profluralin (Tolban)	0.5 to 1 (1 to 2 pt)		Preplant incorporated	No wild mustard control.	7 to 11,27 to 30, 96
Trifluralin (Treflan)	0.5 to 1 (1 to 2 pt)				7 to 11, 27
	0.5 to 1 (10 to 20 lb 5G)		Preplant incorporated, fall		to 30, 96,97
Chloramben (Amiben)	2 to 3 (4 to 6 qt)	Annual grasses and broadleaf weeds	Preemergence	Wild oat control not adequate	97
Trifluralin (Treflan) + Chloramben (Amiben)	0.75 (1.5 pt) + 2 (8 pt)	Grasses and broadleaf weeds	Preplant incorporated	Incorporation of chloramben improved wild mustard control.	8,10, 30,78, 81,97
Barban (Carbyne)	0.5 to 1 (4 to 8 pt)	Wild oats	Wild oats 2-leaf and within 30 days after emergence of crop	Wild oats usually develops to the 2-leaf stage between 4 and 9 days after emergence. Do not mix barban with any other herbicide.	116, 117, 118
Paraquat	0.25 to 0.5 (1 to 2 pt)	Desiccant	Back side of sunflower heads yellow and bracts turning brown. Seed moisture	Registered for oilseed varieties only. Apply with X-77 or other nonionic surfactant. Randomly sample 10 average sized heads for moisture.	129
Sodium chlorate (Oxy Leafex-3, Drop-Leaf)	4.5 to 6 (1.5 to 2 gal)		under 35%.	For use on confectionary and oil grade varieties. Thorough coverage of the plant is essential. Low temperatures slow dessication and require higher rates.	

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Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Paraquat	0.5 (1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or anytime prior to crop emergence	A nonselective, postemergence herbicide. No soil activity. Apply with X-77 or other nonionic surfactant. Good coverage is essential.	129
EPTC **(Eptam)**	2 to 3 (2.3 to 3.4 pt, 20 to 30 lb 10G)	Annual grasses and some broadleaf weeds	Preplant incorporated	Some stand reduction and temporary stunting may occur from the use of EPTC.	7 to 11 15 to 20 25,26,
	4 to 4.5 (4.5 to 5.25 pt 7E, 40 to 45 lb 10G)		Fall incorporated after October 15 until freeze-up	Weak on wild mustard.	101,102
Cycloate **(Ro-Neet)**	3 to 4 (4 to 5.3 pt 6E, 30 to 40 lb 10G)		Preplant incorporated	Sugarbeets have better tolerance to cycloate than to EPTC. Weak on wild mustard. Weed control poor on fine textured, high organic matter soils.	7 to 11
Ethofumesate **(Nortron)**	2 to 3.75 (1.25 to 2.5 gal)	Some annual grasses and broadleaf weeds. Especially good on redroot pigweed	Preplant incorporated in band	Should be used with grass control herbicide.	7 to 11, 33,105
Diallate **(Avadex)**	1.5 to 2 lb (1.5 to 2 qt, 15 to 20 lb 10G)	Wild oats	Spring—preplant incorporated	Keep spring tillage to a minimum.	13,18, 19,102,
			Fall—after October 15 and until freeze-up	Operating tillage implement 4 inches deep does not reduce wild oats control.	113
TCA	4.7 to 7.1 (8 to 12 pt)	Most annual grasses	Preemergence	Weak on wild oats. Do not use sugarbeet tops for livestock feed.	103
Pyrazon **(Pyramin)** + TCA	3.8 to 7.6 + 5 to 7 (5 to 10 lb + 8) to 12 pt)	Annual grasses and most broadleaf weeds		Has been less effective on soils with more than 5% organic matter. Incorporation improves performance of pyrazon.	17
Dalapon **(Dowpon)**	2 to 3 (2.7 to 4 lb)	Most annual grasses	Apply from emergence to 6-leaf stage of sugarbeets. Use directed spray after beets have 6 leaves	Use high rate if grasses have over 4 leaves or if they are growing slowly due to dry conditions. May be applied more than once up to a maximum of 5.9 lb/A per year. Some yield reduction may occur from rates over 3 lb/A. Add any nonionic surfactant at 0.5 to 2 pints per 100 gal. spray solution.	104
Endothall **(Herbicide 273)**	0.75 to 1.5 (2 to 4 pt)	Wild buckwheat, smartweed, marshelder	Sugarbeets should have 4 to 6 leaves. Do not apply later than 40 days after emergence	When temperatures are over 80F, endothall may cause excessive injury, especially to very small sugarbeets. Endothall is ineffective at temperatures below 60F.	104

Table Continued . . .

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Sugarbeets (continued)

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Phenmedipham (**Betanal**)	1 to 1.5 (6.1 to 9.2 pt)	Most annual broadleaf weeds except redroot pigweed	Postemergence when broadleaf weeds are between cotyledon and four-leaf stage and the sugarbeets are in the four-leaf stage or later	To avoid sugarbeet injury, use no more than 1 lb/A following EPTC or TCA. Do not apply if highest temperature during day is over 85F and apply late in the afternoon or early in the evening.	106
Desmediapham (**Betanex**)	1 to 1.25 (6.1 to 7.7 pt)	Most annual broadleaf weeds including pigweed			
Barban (**Carbyne**)	0.75 to 1 lb (3 to 4 qt)	Wild oats	Wild oats 2-leaf and within 30 days after emergence of crop	Wild oats usually develops to the 2-leaf stage between 4 and 9 days after emergence. Do not mix barban with any other herbicide.	116, 117
Trifluralin (**Treflan**)	0.75 lb (1.5 pt)	Grasses and some broadleaf weeds	Sugarbeets 2 to 6 inches tall and well-rooted to withstand incorporation	Must be incorporated. Exposed beet roots must be covered with soil before application. Emerged weeds not controlled. May be applied over the tops of sugarbeets.	107

Tame Mustard

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Trifluralin (**Treflan**)	0.5 to 0.75 (1 to 1.5 pt)	Grasses and broadleaf weeds	Preplant incorporated	Use lower rate on coarse textured, low organic matter soils.	7 to 11 27 to 33
Barban (**Carbyne**)	0.37 lb (3 pt)	Wild oats	Wild oats 2-leaf and within 30 days after emergence of crop	Wild oats usually develops to the 2-leaf stage between 4 and 9 days after emergence. Do not mix barban with any other herbicide.	116 to 118

Potatoes

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Dalapon (**Dowpon**)	6 (8 lb)	Quackgrass	Preplant in spring when grass is 4 to 6 inches tall	Plow after 4 days and potatoes may be planted immediately.	
EPTC (**Eptam**)	3 to 6 (3.5 to 6.75 pt)	Grasses and some broadleaf weeds	Preplant, dragoff, or directed spray at layby	Weak on wild mustard.	7 to 11 16,18, 20
	4 to 6 (4.5 to 7 pt 7E, 40 to 60 lb 10G)		Fall incorporated after October 15 until freeze-up		
Diallate (**Avadex**)	1.5 to 2 lb (1.5 to 2 qt)	Wild oats	Preplant incorporated	Incorporate immediately. Operating incorporation implement 4 inches deep does not reduce wild oats control.	7 to 11, 19,113
Paraquat	1 (2 qt)	Most annual grasses and broadleaf weeds	Preemergence—when weeds are up but before crop emerges	Do not apply later than ground cracking. Paraquat kills only emerged weeds. Apply with X-77 or other nonionic surfactant.	129

Table Continued . . .

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Potatoes (continued)

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Linuron **(Lorox)**	0.75 to 2 (1.5 to 4 lb)	Most annual grasses and broadleaf weeds	Preemergence (just before crop emerges)	Apply to crop planted 2 inches deep, after dragoff or hilling. Do not plant to other crops within 4 months after treatment. Use higher rates on fine textured soils.	17
Metribuzin **(Lexone, Sencor)**	0.5 to 1 (1 to 2 lb WP, 1 to 2 pt FL, 0.67 to 1.33 lb DF)	Broadleaf weeds including wild mustard and some grasses	Preemergence or postemergence (on white skinned, late maturing varieties)	Use lower rate on coarse textured soils. Soil residue harmful to following susceptible crops may occur. See label for details.	27,32
Trifluralin **(Treflan)**	0.5 to 1 (1 to 2 pt)	Grasses and broadleaf weeds	After planting, up to or immediately following dragoff	Must be incorporated. Care should be taken that incorporation machinery does not damage seed pieces or elongating sprouts.	7 to 11 27,30
Trifluralin **(Treflan)** + EPTC **(Eptam)**	0.5 + 1.5 to 4 (1 pt + 1.75 to 4.5 pt)			Must be incorporated immediately. Enhances wild oats control compared to trifluralin alone. Reduces potential carryover of trifluralin.	7 to 11

Potato Vine Killing

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Endothall **(Des-i-Cate)**	0.75 to 1 (1.5 to 2 gal)	Desiccant	10 to 14 days prior to harvest	Use higher rate during cool, cloudy weather and on heavy vine growth	
Dinoseb oil soluble **(Dow General)**	1.25 to 2.5 (2 to 4 pt)			Rate depends on temperature, spray volume, potato variety and vigor of the vines.	
Paraquat	0.25 to 0.5 (1 to 2 pt)		More than 3 days prior to harvest	Do not use when the potatoes are to be stored or used for seed.	

Grass — Seedling

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
2,4-D	0.5 to 0.75 (1 to 1.5 pt of 4 lb/gal conc.)	Broadleaf	After 3-leaf stage of grasses	Use rate listed for established grasses after tillering of seedling grass.	

Grass — Established

(See later section for control of specific perennial weeds)

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
2,4-D	0.75 to 2 (1.5 to 4 pt of 4 lb/gal conc.)	Annual and perennial broadleaf weeds	Weeds—emergence to bud stage; preferably when young and actively growing	Do not graze dairy cows for 7 days after application. Do not apply after boot stage on grasses for seed production. Use 1 lb/A on annuals and gumweed and 2 lb/A on sages and other perennials.	

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**Reference paragraph number indicates appropriate paragraph in the narrative.

Legumes

Alfalfa and clover with companion crop

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
MCPA amine	0.12 to 0.25 (0.25 to 0.5 pt of 4 lb/gal conc.)	Broadleaf	Legumes 2 to 3 inches tall and companion crop 8-leaf to early boot	NOTE: POSSIBLE INJURY TO SWEETCLOVER AND ALFALFA. Use only when weed problem is severe.	109
Dinoseb, amine salt **(Premerge)**	1.1 to 1.5 (1.5 to 2 qt)	Small broadleaf weeds	Grain—2 or more leaves and weeds small	Apply in 30 gal/A of water. Burning of grain leaves is not ordinarily harmful. Do not graze or feed forage within 6 weeks after spraying.	109

Alfalfa, trefoil establishment, no companion crop

EPTC **(Eptam)**	3 to 4 (3.5 to 4.5 pt)	Grasses and some broadleaf weeds	Preplant incorporated	Weak on wild mustard.	110

Alfalfa or trefoil. Establishment or established

2,4-DB	0.5 to 1 (1 to 2 pt of 4 lb/gal conc.)	Broadleaf	Weeds and legumes less than 3 inches tall	Sweetclover may be killed by 2,4-DB. Wild mustard control generally not adequate. 2,4-DB must be applied 30 days before hay harvest or grazing.	109

Alfalfa establishment

Glyphosate **(Roundup)**	0.37 to 0.75 (1 pt to 1 qt)	Emerged annual grasses and broadleaf weeds	Preplant or anytime prior to crop emergence	A nonselective, translocated, postemergence herbicide. No soil residual activity. Use lower rate for annual grasses.	130

Alfalfa established

Simazine **(Princep)**	0.8 to 1.6 (1 to 2 lb 80W)	Grasses and broadleaf weeds including downy brome, wild oats and kochia	After last cutting but before freeze-up	Do not use on sands or loamy sands or where soil pH is above 7.5. Use low rate on sandy loam. Apply to pure strands of alfalfa established at least 12 months.	109
Metribuzin **(Lexone, Sencore)**	0.37 to 1 (0.75 to 2 lb WP, 0.75 to 2 pt FL, 0.5 to 1.25 lb DF)		Early spring to dormant alfalfa	May be applied on frozen soil. Do not apply to alfalfa during the first growing season after seeding. Rate depends on weeds present.	

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**Reference paragraph number indicates appropriate paragraph in the narrative.

CHEMICAL WEED CONTROL
For Fallow

For future planting to wheat, barley, oats, corn or sorghum

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Cyanazine **(Bladex 80WP)**	2.4 to 3.2 (3 to 4 lb/A)	Annual broadleaf and grass weeds	Fall—anytime after harvest but before weeds emerge	Use higher rates on fine textured soils. If 0.5 inch of rainfall is not received within 10 days after application, under cutting with sweeps may be desirable to destroy weeds until cyanazine is activated. Do not use Bladex 4L.	131
	1.6 to 2.8 (2 to 3.5 lb/A)		Early spring before weeds emerge		
Cyanazine **(Bladex 80WP)** + Atrazine	2 to 2.8 + 0.5	Annual broadleaf and grass weeds	Fall—anytime after harvest but before weeds emerge	Mixture must be applied before November 15 for winter wheat the following year and allow 12 or more months between application and sowing of spring-seeded small grain.	132
	2 to 2.8 + 0.4		Early spring before weeds emerge		
Cyanazine **(Bladex 80WP)** + Paraquat	2.4 to 3.2 (3 to 4 lb/A) + 0.5 (1 qt/A)	Annual broadleaf and grass weeds	Fall—anytime after harvest if weeds have emerged	Use only if weeds have emerged at time of application. Use higher rates of cyanazine on fine textured soils.	131
	1.6 to 2.8 (2 to 3.5 lb/A) + 0.5 (1 qt/A)		Spring—after weeds have emerged		
Propham **(Chem Hoe 135)**	3 to 4 lb/A (4 to 5.3 pt)	Wild oats, downy brome and volunteer grain	Late fall	Apply in late fall after soil temperatures have cooled to 50F or cooler in upper inch of soil. Use higher rate on medium to fine textured soils.	133
2,4-D	0.75 to 2 (1.5 to 4 pt of 4 lb/gal conc.)	Annual and perennial broadleaf weeds	Postemergence	Use higher rates for perennial weeds.	
Dicamba **(Banvel)**	0.25 to 0.5 (0.5 to 1.0 pt)	Wild buckwheat, kochia and other broadleaf annuals		Residue damaging to broadleaf crops the next year may be possible with fall application.	
Paraquat	0.5 (1 qt)	Emerged annual grasses and broadleaf weeds	Weeds less than 6 inches tall	A nonselective, contact postemergence, herbicide. No soil residual activity.	129
Glyphosate **(Roundup)**	0.37 to 0.75 (1 pt to 1 qt)			A nonselective, translocated, postemergence herbicide. No soil residual activity. Use lower rate on annual grasses.	130

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**Reference paragraph number indicates appropriate paragraph in the narrative.

For future planting to wheat

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Atrazine	0.5 to 1 (0.6 to 1.25 80W)	Annual broadleaf weeds and grasses including downy brome	Apply before weeds emerge	Plant at least 2 inches deep and allow 12 or more months between application and planting. Do not use on sandy soils, eroded hillsides, caliche and rocky outcroppings or exposed calcareous subsoil.	132
Atrazine + Paraquat	0.5 to 1 + 0.25 to 0.5 (0.6 to 1.25 80W + 1 to 2 pt)		Weeds emerged but less than 6 inches tall		
Atrazine + terbutryn **(Igran)**	0.5 to 1 + 1.6 to 2	Annual broadleaf weeds and grasses including downy brome	Weeds emerged but less than 6 inches tall	Apply with a nonionic surfactant at 1 to 2 pints per 100 gallons.	132

SPECIAL ANNUAL WEED PROBLEMS

Fumitory

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Crop	When to Apply	Remarks	Reference**
Triallate **(Far-go)**	1.25 lb (1.25 qt)	Barley	Immediately after planting	Incorporate in top 2 inches of soil by cultivation. Wheat must be below incorporated zone.	8
	1 lb (1 qt)	Wheat and durum			
Diallate **(Avadex)**	1.5 lb (1.5 qt)	Flax	Preplanting		
Bromoxynil **(Brominal, Buctril)** + MCPA ester	0.25 to 0.37 lb + 0.25 to 0.37 lb	Wheat, barley and oats	After fumitory is established to boot stage of crop	Other broadleaf weeds also will be controlled. Commercial mixtures (Brominal Plus and Bronate) are available.	37

Downy Brome
(Cheatgrass)

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Crop	When to Apply	Remarks	Reference**
Atrazine **(AAtrex)**	0.8 to 1.0 lb (1 to 1.25 lb 80W, 1.6 to 2 pt 4L)	Rangeland	Fall—late September until freeze-up	Apply in minimum of 10 gallons of water per acre. Grazing permissible 7 months after application.	

False Chamomile

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Crop	When to Apply	Remarks	Reference**
Bromoxynil **(Brominal, Buctril)** + MCPA ester	0.37 lb + 0.37 lb	Wheat, barley and oats	Chamomile less than 4 inches tall	Control of fall germinated plants will be less than those germinating in the spring.	47
Picloram **(Tordon 22K)**	0.25 to 0.37 lb/A	Roadsides		Use higher rate on plants over 4 inches tall. Avoid drift of picloram to sensitive plants.	

Table Continued . . .

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Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
Paraquat	0.5 lb (1 qt)	Tree rows or potholes	Chamomile less than 6 inches tall	Apply with X-77 or other non-ionic surfactant at 1 qt per 100 gal water. Avoid contact with desirable plants.	129
Glyphosate (Roundup)	0.75 (1 qt)			Avoid contact with desirable plants.	130
Amitrole (Amitrole T, Cytrol)	1.5 lb (3 qt)	Tree rows or potholes	Chamomile less than 6 inches tall	Avoid contact with desirable plants.	130

CHEMICAL WEED CONTROL
For Perennial Weeds

Field Bindweed

Fallow or post harvest

Herbicide 1/	Act. Ingred. Lb/A or Sq. Rd. (Formulation/A)*	When to Apply	Remarks	Reference**
2,4-D L.V. ester or oil soluble amine	1 to 2 lb/A (1 to 2 qt/A of 4 lb/gal conc.)	Regrowth 6 inches to bud	Cultivate fallow until early July. Spray in late August or September. Respray in follow-year's crop.	121, 126
Glyphosate (Roundup)	3 to 3.75 lb/A (4 to 5 qt/A	Bud and/or flower stage and actively growing	Cultivate fallow until early July. Spray in late August or September. Allow 7 or more days after application before tillage. Only barley, oats, wheat, corn, soybeans, dry beans and alfalfa may be planted within 1 year following application. Repeat applications are required for complete control.	122, 123
		Wheat and barley		
2,4-D amine 2,4-D L.V. ester	0.75 lb/A 0.66 lb/A	Tiller stage of crop	Rates higher than listed may injure crop but may be beneficial, especially in small areas, to control bindweed.	121, 126
		Patches or individual plants in cropland		
Glyphosate (Roundup)	3 to 3.75 lb/A (4 to 5 qt/A)	Prior to heading or flowering of crops, bindweed in bud and/or flowering stage and actively growing	Crop in the treated area will be killed. Avoid drift. Approved only for barley, corn, oats, soybeans, wheat, dry beans and alfalfa. Repeat applications are required for complete control.	122, 123

Table Continued . . .

1/ Several soil sterilants will control perennial weeds. Follow directions on the label.

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Field Bindweed (continued)

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
			Patches or individual plants in pastures or noncropland[2/]		
Picloram (Tordon)	1 lb/A (2 qt/A S, 50 lb G)		Bindweed actively growing	Picloram granules available. Do not use in areas with high water table.	124, 125
Dicamba (Banvel)	4 to 8 lb/A (1 to 2 gal/A)			Apply to foliage and/or soil. Consult label for grazing restrictions.	127
			Trees		
Glyphosate (Roundup)	3 to 3.75 lb/A (4 to 5 qt/A)		Bindweed actively growing	Avoid spraying tree foliage. A nonselective herbicide. Repeat applications are required for complete control.	122, 123

[1/] Several soil sterilants will control perennial weeds. Follow directions on the label.

[2/] Noncropland means roadsides and waste areas not used to produce animal feed.

Leafy Spurge

Herbicide[1/]	Act. Ingred. Lb/A or Sq. Rd. (Formulation/A)*	When to Apply	Remarks	Reference**
		On fallow		
2,4-D L.V. ester	1 to 2 lb/A (1 to 2 qt/A of 4 lb/gal conc.)	4 to 6 inches	Cultivate or respray whenever regrowth is 4 to 6 inches high. Respray in following year's crop.	121, 126
		Pasture and rangeland		
2,4-D L.V. ester or oil soluble amine	1 to 2 lb/A (1 to 2 qt/A of 4 lb/gal conc.)	Early bud stage and fall	Apply both spring and fall for satisfactory control. Do not graze dairy cows for 7 days after treatment.	121, 126
Picloram (Tordon 22K)	0.5 lb/A (2 pt/A)	Spurge actively growing	Retreatment at the same rate usually will be necessary the following year.	124, 125
	Roller applicator solution 1 part picloram: 7 parts water + 0.5 to 1% nonionic surfactant	Spurge 15 to 20 inches tall until freeze-up	Retreatment with 2,4-D at 1 to 2 lb/A may be needed the following year to control seedlings.	
		Patches or individual plants in pastures		
Dicamba (Banvel)	4 to 8 lb/A (1 to 2 gal/A)	Spurge actively growing	Apply to foliage and/or soil. Consult label for grazing restrictions.	127
Picloram (Tordon)	1 to 2 lb/A (2 to 4 qt/A S, 50 to 100 lb G)		Consult reference for grazing restrictions.	124, 125
		Trees		
Glyphosate (Roundup)	1 to 1.5 lb/A (1.5 to 2 qt/A)	After July 1 and spurge actively growing	Avoid spraying tree foliage. A nonselective herbicide.	122, 123

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Canada Thistle and Sowthistle

Wheat and Barley

Herbicide[1/]	Act. Ingred. Lb/A or Sq. Rd. (Formulation/A)*	When to Apply	Remarks	Reference**
MCPA amine MCPA ester	0.75 lb/A 0.66 lb/A	Tiller stage of crop	Higher rates than listed may injure crop but may be beneficial especially in small areas, to achieve thistle control.	121

Corn

Atrazine	4 lb/A (1 gal/A 4L, 5 lb/A 80W)	Apply 2 lb/A in the fall or early spring and an additional 2 lb/A before, at, or after planting. Also two postemergence treatments with oil 10 to 20 days apart.	Plant only corn year following treatment	29,58

Patches or individual plants in cropland

Glyphosate **(Roundup)**	1.5 to 2.25 lb/A (2 to 3 qt/A)	Prior to heading or flowering of crop, thistles at or beyond the bud stage of growth	Only barley, oats, wheat, corn, soybeans, dry beans and alfalfa may be planted within 1 year following application. Crop in treated area will be killed. Avoid drift.	122, 123

Fallow or post harvest

2,4-D	1 lb/A (1 qt/A of 4 lb/gal conc.)	6 inches tall and actively growing.	Cultivate fallow until early July. Spray in late August or	121, 126,
Dicamba **(Banvel)**	1 to 2 lb/A (1 to 2 qt/A)	Post harvest mowing promotes active regrowth	September.	127
Glyphosate **(Roundup)**	1.5 to 2.25 lb/A (2 to 3 qt/A)	Thistles at or beyond the bud stage of growth	Allow 3 or more days after application before tillage. Only barley, oats, wheat, corn, soybeans, dry beans and alfalfa may be planted within 1 year of application. Has not been tested on perennial sowthistle.	122, 123

Trees

Glyphosate **(Roundup)**	1.5 to 2.25 lb/A (2 to 3 qt/A)	Thistles at or beyond the bud stage of growth	Avoid spraying tree foliage.	

Pasture and Rangeland

Picloram **(Tordon 22K)**	0.25 to 0.5 lb/A (1 to 2 pt/A)	6 inches tall and actively growing. For fall treatment, mowing promotes active growth	Retreatment at the same rate usually will be necessary the following year.	124, 125
Dicamba **(Banvel)**	0.5 lb/A (1 pt/A)		Consult label for grazing restrictions.	127
2,4-D	1 to 2 lb/A)1 to 2 qt/A of 4 lb/gal conc.)		Do not graze dairy cows for 7 days after treatment.	121, 126

Table Continued . . .

1/ Several soil sterilants will control perennial weeds. Follow directions on the label.

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Canada Thistle & Sowthistle (continued)

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
			Patches or individual plants in pastures		
Picloram (Tordon)	1 lb/A (2 qt/A S, 50 lb G)		When thistles are actively growing	Consult reference for grazing restrictions.	124, 125
Dicamba (Banvel)	4 lb/A (1 gal/A)			Consult label for grazing restrictions.	127

Common Milkweed

Herbicide[1/]	Act. Ingred. Lb/A or Sq. Rd. (Formulation/A)*	When to Apply	Remarks	Reference**
		Fall or post harvest		
Glyphosate (Roundup)	2.25 lb/A (3 qt/A)	Late bud to flower stage and actively growing	Allow 3 or more days after application before tillage. Only barley, oats, wheat, corn, soybeans, dry beans and alfalfa may be planted within 1 year following application.	122, 123
		Patches or individual plants in cropland		
Glyphosate (Roundup)	2.25 lb/A (3 qt/A)	Prior to heading or flowering of crop, milkweed in late bud to flower stage and actively growing	Allow 3 or more days after application before tillage. Only barley, oats, wheat, corn, soybeans, dry beans and alfalfa may be planted within 1 year following application. Crop in treated area will be killed. Avoid drift.	122, 123
		Pasture and rangeland		
Picloram (Tordon)	0.5 lb/A (2 pt/A S, 50 lb G)	Actively growing	Retreatment at the same rate usually will be necessary the following year.	124, 125
		Patches or individual plants in pastures		
Picloram (Tordon)	1 to 2 lb/A (2 to 4 qt/A S, 50 to 100 lb G)	Actively growing	Consult reference for grazing restrictions.	125

Quackgrass

Herbicide[1/]	Act. Ingred. Lb/A or Sq. Rd. (Formulation/A)*	When to Apply	Remarks	Reference**
		Fallow		
Dalapon (Dowpon)	6 to 11 lb/A (8 to 14.75 lb/A)	On fallow after 4 to 6 inches growth.	Cultivate after 10 to 20 days.	

Table Continued . . .

1/ Several soil sterilants will control perennial weeds. Follow directions on the label.

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Quackgrass (continued)

Herbicide	Act. Ingred. lb/A (Formulation/A)*	Weeds	When to Apply	Remarks	Reference**
			Corn		
Atrazine	4 lb/A (5 lb/A 80W)		Apply 2 lb/A in the fall or early spring and an additional 2 lb/A before, at, or after planting time	First application 10 days to 2 weeks prior to plowing. Plant only corn year of application and year following treatment. A total of 3 lb/A is adequate on sandy soils.	29, 58
			Patches or individual plants in cropland		
Glyphosate **(Roundup)**	1.5 to 2.25 lb/A (2 to 3 qt/A)		Prior to heading or flowering of the crop, quackgrass at least 8 inches tall	Allow 3 or more days after application before tillage. Only barley, oats, wheat, corn, soybeans, dry beans and alfalfa may be planted within 1 year following application. Crop in treated area will be killed. Avoid drift.	122, 123
			Preplant, fallow or post harvest		
Glyphosate **(Roundup)**	1.5 to 2.25 lb/A (2 to 3 qt/A)		At least 8 inches tall at 3 to 4 leaf stage and actively growing	Allow 3 or more days after application before tillage. Only barley, oats, wheat corn, soybeans, dry beans and alfalfa may be planted within 1 year following application. Crop in treated area will be killed. Avoid drift.	122, 123

Around Buildings, Telephone Poles, Etc.

Herbicide[1/]	Act. Ingred. Lb/A or Sq. Rd. (Formulation/A)*	When to Apply	Remarks	Reference**
Atrazine, bromacil, diuron, prometone, simazine or similar products	See label	Any time during and prior to growing season. See label	Use high rate for complete long-term soil sterility.	

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GLOSSARY OF CHEMICAL NAMES

TRADE NAME[1/] AND MANUFACTURER	COMMON NAME	CONCENTRATION AND COMMERCIAL FORMULATIONS[2/]
Amiben (Rhone-Poulanc)	Chloramben	10% G 2 lb/gal S
Amitrole T (Union Carbide)	Amitrole	2 lb/gal S
Atrazine (Various)	Atrazine	80% WP, 90% DF 4 lb/gal F
Avadex (Monsanto)	Diallate	4 lb/gal E 10% G
Avenge (American Cyanamid)	Difenzoquat	2 lb/gal S
Banvel (Velsicol)	Dicamba	4 lb/gal S
Basagran (BASF)	Bentazon	4 lb/gal S
Basalin (BASF)	Fluchloralin	4 lb/gal E
Betanal (Nor-Am)	Phenmedipham	1.3 lb/gal E
Betanex (Nor-Am)	Desmedipham	1.3 lb/gal E
Bicep (Ciba-Geigy)	Atrazine + metolachlor	2 + 2½ lb/gal F
Bladex (Shell)	Cyanazine	80% WP, 15% G 4 lb/gal F
Blazer (Rohm & Haas)	Acifluorfen	2 lb/gal E
Brominal (Union Carbide)	Bromoxynil	2 lb/gal E
Brominal Plus (Union Carbide)	Bromoxynil and MCPA	2 lb/gal MCPA plus 2 lb/gal bromoxynil E
Bronate (Rhone-Poulanc)	Bromoxynil and MCPA	2 lb/gal MCPA plus 2 lb/gal bromoxynil E
Buctril (Rhone-Poulanc)	Bromoxynil	2 lb/gal E
Butyrac Ester & 200 (Union Carbide)	2,4-DB	2 lb/gal E, S
Butoxone (Rhone-Poulanc)	2,4-DB	1.75 lb/gal amine S 2 lb/gal ester E
Carbyne (Velsicol)	Barban	1 lb/gal E
Chem-Hoe 135 (PPG)	Propham	3 lb/gal F
Chem-Hoe FL4 (PPG)	Propham	4 lb/gal F
Cytrol (American Cyanamide)	Amitrole	2 lb/gal S

1/ "Various" means there are numerous trade names and manufacturers for the chemical. The mention of trade names does not imply that they are endorsed or recommended over those of similar nature not listed.

2/ G = granule, E = emulsifiable concentrate, F = liquid flowable, DF = dry flowable, SP = soluble powder, S = solution, WP = wettable powder.

TRADE NAME[1/] AND MANUFACTURER	COMMON NAME	CONCENTRATION AND COMMERCIAL FORMULATIONS[2/]
Des-i-Cate (Pennwalt)	Endothall (As a desiccant)	0.52 lb/gal S
Dow General (Dow)	Dinoseb (DNBP) oil soluble	5 lb/gal E
Dowpon M (Dow)	Dalapon	74% SP
Drop-Leaf (Thompson-Hayward)	Sodium chlorate	3 lb/gal S
Dual (Ciba-Geigy)	Metolachlor	8 lb/gal E
Dyanap (Uniroyal)	Naptalam + dinoseb	3 lb/gal E
Eptam (Stauffer)	EPTC	7 lb/gal E 10% G
Eradicane (Stauffer)	EPTC plus R-25788	6.7 lb/gal E
Evik (Ciba-Geigy)	Ametryne	80% WP
Far-go (Monsanto)	Triallate	4 lb/gal E 10% G
Herbicide 273 (Pennwalt)	Endothall	3 lb/gal S
Hoelon (American Hoechst)	Diclofop	3 lb/gal E
Hyvar-X (DuPont)	Bromacil	80% WP
Hyvar-XL (DuPont)	Bromacil	2 lb/gal S
Igran (Ciba-Geigy)	Terbutryn	80% WP
Karmex (DuPont)	Diuron	80% WP
Lasso (Monsanto)	Alachlor	4 lb/gal E 15% G
Lexone (DuPont)	Metribuzin	75% DF 4 lb/gal F
MCPA (Various)	MCPA	Various E, S
Modown (Mobil)	Bifenox	80% WP 4 lb/gal F
MonDak (Velsicol)	Dicamba plus MCPA	1.25 lb/gal dicamba plus 2.5 lb/gal MCPA S
Nortron (Fisons)	Ethofumesate	4 lb/gal F 1.5 lb/gal E
Ortho Paraquat (Chevron)	Paraquat	2 lb/gal S
Oxy Leafex-3 (Occidental)	Sodium chlorate	3 lb/gal S

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TRADE NAME[1/] AND MANUFACTURER	COMMON NAME	CONCENTRATION AND COMMERCIAL FORMULATIONS[2/]
Premerge (Dow)	Dinoseb amine salt	3 lb/gal S
Princep (Ciba-Geigy)	Simazine	80% WP, 4 lb/gal F 4% G
Propachlor (Various)	Propachlor	65% WP 4 lb/gal F 20%G
Prowl (American Cyanamid)	Pendimethalin	4 lb/gal E
Pyramin (BASF)	Pyrazon	75.5% WP 4.2 lb/gal F
Ro-Neet (Stauffer)	Cycloate	6 lb/gal E 10%
Roundup (Monsanto)	Glyphosate	3 lb/gal S
Sencor (Mobay)	Metribuzin	4 lb/gal F 50% WP
Sodium Chlorate (Riverside Chemical Co.)	Sodium chlorate	3 lb/gal S
Stampede (Rohm & Haas)	Propanil	2 lb/gal E
Sutan + (Stauffer)	Butylate	6.7 lb/gal L 10% G
TCA (Hopkins)	TCA	4.76 lb/gal S
Tolban (Ciba-Geigy)	Profluralin	4 lb/gal E
Tordon 22K (Dow)	Picloram	2 lb/gal S
Tordon 2K (Dow)	Picloram	2% G
Treflan (Elanco)	Trifluralin	4 lb/gal E 5% G
2,4-D (Various)	2,4-D	Various E, S

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2/ G = granule, E = emulsifiable concentrate, F = liquid flowable, DF = dry flowable, SP = soluble powder, S = solution, WP = wettable powder.

RELATIVE HERBICIDE EFFECTIVENESS ON WEEDS AND PERSISTENCE IN SOIL

	Barnyardgrass	Cocklebur	Field bindweed & per. thistle	Foxtails (Pigeongrass)	Kochia	Lambsquarters	Pigweed, redroot	Russian thistle	Sunflower, volunteer	Wild buckwheat	Wild mustard	Wild oat	Herbicide Persistence After 12 months
PREPLANT INCORPORATED													
EPTC **(Eptam)**	G	P	N	G	F	G	G	P	N	F	P	G	N
Ethofumesate **(Nortron)**	P	P	N	F-G	F-G	P	G	—	P	G	F	F-G	O
Fluchloralin **(Basalin)**	G	P	N	G	G	G	G	G	N	F	N	F	S
Pendimethalin **(Prowl)**	G	N	N	G	F-G	G	G	F	N	N	N	F	S
Profluralin **(Tolban)**	G	P	N	G	G	G	G	G	N	F	N	F	S
Trifluralin **(Treflan)**	G	P	N	G	G	G	G	G	N	F	N	F	S
PREEMERGENCE INCORPORATE													
Di- & Triallate **(Avadex, Far-go)**	N	N	N	N-F	N	N	N	N	N	N	N	G	N
Trifluralin **(Treflan)**	G	N	N	G	F	F	F	F	N	N	N	P-N	S
PREEMERGENCE													
Alachlor **(Lasso)**	G	N	N	G	F	F	G	F	N	F	P	P	N
Atrazine **(AAtrex)**	G	F	P	G	G	G	G	G	F	G	G	G	O
Chloramben **(Amiben)**	G	P	N	G	F	G	G	G	N	G	F	F	N
Cyanazine **(Bladex)**	F	F	N	G	F	G	F	G	F	G	G	P	N
Metolachlor **(Dual)**	G	N	N	G	F	F	G	F	N	F	P	N	N
Metribuzin **(Lexone, Sencor)**	G	F	N	G	G	F	G	G	N	F	G	P	S
Pendimethalin **(Prowl)**	G	N	N	G	F-G	G	G	F	N	N	N	F	S
Propachlor **(Bexton, Ramrod)**	G	P	N	G	G	F	G	P	N	F	P	P	N
TCA	G	N	N	G	N	N	N	N	P	N	N	P	N
POSTEMERGENCE													
Acifluorfen **(Blazer)**	N	G	F	P	F-G	F	G	—	P	G	G	N	N
Atrazine + oil	G	G	P	G	G	G	G	G	G	G	G	G	S
Barban **(Carbyne)**	N	N	N	N	N	N	N	N	N	P	N	G	N
Bentazon **(Basagran)**	N	G	F	N	—	P-F	P-F	P	G	P	G	N	N
Bromoxynil + MCPA **(Brominal Plus, Bronate)**	N	G	F	N	G	G	G	G	G	G	G	N	N
Dalapon **(Dowpon)**	G	N	N	G	N	N	N	N	N	N	N	F	N
Desmedipham **(Betanex)**	P	P	N	P	F	G	G	F	P	F	G	N	N
Dicamba **(Banvel)**	N	G	G	N	G	G	G	F-G	G	G	F	N	S
Dicamba + MCPA **(Mondak)**	N	G	G	N	G	G	G	F-G	G	G	G	N	N
Diclofop **(Hoelon)**	F	N	N	G	N	N	N	N	N	N	N	G	N
Difenzoquat **(Avenge)**	N	N	N	N	N	N	N	N	N	N	N	G	N
Endothall **(Herbicide 273)**	N	P	N	N	P	P	F	P	P	G	F	N	N
MCPA	N	G	G	N	F	G	F	N	F-G	N	G	N	N
Phenmedipham **(Betanal)**	P	P	N	F	F	G	P	F	P	G	G	N	N
Picloram **(Tordon 22K)** + 2,4-D	N	G	G	N	F	G	G	G	G	G	G	N	O
Propanil **(Stampede)**	F	F	N	G	F	G	G	P	F	G	F	N	N
2,4-D	N	G	G	N	F	G	G	F-G	G	P	G	N	N

G = Good F = Fair P = Poor N = None S = Selection O = Often

This table is a general comparative rating of the relative effectiveness of herbicides to certain weeds and persistence of herbicides in soil. Under very favorable weather conditions, control might be better than indicated. Under unfavorable conditions, some herbicides rated good or fair might give erratic or unfavorable results. Also, relatively dry and/or cool weather increases herbicide persistence while wet and/or warm weather reduces herbicide persistence.

OTHER WEED AND WEED CONTROL EXTENSION CIRCULARS AND PUBLICATIONS

W-218 Weed Seeds and Seedlings
W-295 Leafy Spurge Control
W-418 Chemical Weed Control in Trees
H-432 Weed Control in Lawns
W-564 Leaf Stages in Small Grains
W-565 Cultural Control of Wild Oats
W-578 North Dakota Noxious Weeds Law and Regulations
W-617 Weed Control in Flax
W-657 Herbicide Spray Drift
AE-73 Sprayer Equipment and Calibration
A-471 Plants Which May be Poisonous
A-600 The Soil Organic Matter Test as a Herbicide Use Guide
Cir. Bb-7 Identifying Weeds and Their Seeds

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